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*THE CULTURAL VALUE OF ENGINEERING EDUCATION.**

AT the very outset of this discussion is encountered a great difficulty. What is culture? The writer has been asking this of his friends. An answer has been sought for in the printed page where is recorded the best thought of the best minds. Great thoughts and lofty ideals have been disclosed, but nowhere has been found a satisfactory definition, a phrase or paragraph that succinctly and clearly sets forth the heart of the matter.

People often recognize, appreciate and reverence its possession without being able to fully analyze and set down its elements. There is something subtile and emotional about it that eludes a close pursuit.

The reason for this perhaps lies in its essential individual quality, in its being the result of a personal life, developed, it is true, on lines similar to those used in other lives, yet including something that pertains exclusively to the human unit that is different from all other units.

Nevertheless, there seem to be certain fundamental qualities which must be possessed before a man can be classed with cultured people, qualities which are only acquired after a considerable experience in

*Address of the President of the Society for the Promotion of Engineering Education, Buffalo meeting, June 29, 1901.

life, but which are influenced greatly by the years of student training and therefore fit subjects for discussion here. Far be it from the purpose of this paper to attempt a definition of culture or a setting forth of its elements in any completeness; rather the emphasizing of some things that relate to it, especially with reference to the education of young engineers.

First: The man of culture must be a thinking and reflecting being. There must be not only the ability, but the habit; and this is no easy thing to acquire. Modern American life is full of hurry, full of affairs that demand instant attention, and one matter follows another with rapid succession. We get news from Pekin to-day, from Havana to-morrow and from the Philippines within a few hours. We build railways, erect bridges and fill large orders for locomotives for foreign shipment in such short space of time as to astonish the world. Men seek short cuts to fortune. In the popular opinion, the men who act quickly, the men of decision, are those who succeed. But there is a danger here. For, back of the action, behind the sharp decision, must lie a mature judgment, and how else is this to be formed except as a result of deliberate reflection. However quickly one may reach a conclusion, its correctness or faultiness will depend not on intuition, but on the degree of true comprehension. The decisive act which is also right rests on a process of thinking and judging that has been long fostered, until it has become a habit, until there are established certain standards by which things are to be measured.

The early steps of this training are necessarily slow, and we, as teachers of engineers, must recognize this and not yield to the temptation to crowd our students over too much ground on the one hand, or, on the other, to lead them through short cuts across country by empirical paths that may give them ease and quickness of travel, but little or no reason why the path is chosen. Let them go the long road. I do not by any means wish our teaching to be non-practical—rather more practical in the best sense; but first, last and all the time, let students be trained to do their own thinking and to form their own judgments; to test the statements of others by the workings of their own mental processes.

Second: There is another element of culture that comes in here, an ethical one, that of forming right judgments. Men may have the appearance of culture without its true spirit, which is essentially honest. This is especially important, as culture seeks to make a man's life satisfactory to himself when measured by his own conscience, as well as successful in the field of affairs. So his standards must be based on sound principles of right and wrong; and it is only when these are so placed that his life becomes one of freedom, freedom from the bondage that wrong thinking and acting always bring. A class room is no place to preach a sermon, but there can be there imparted a respect for truth and perfect honesty. A teacher's attitude should always be open and frank, that of a sincere seeker after truth. He should never dodge an honest question, and be ever ready to say 'I do not know' if he does not. There is an incalculable power that 'makes for righteousness' and the happiness of the after life of the student in the true teacher's conduct of even such a material subject as mechanics.

Back behind the subject with its subdivisions, its formulæ and rules, lies something larger, a sort of spiritual quality that binds it to all other subjects, to the universe as a whole, and makes it a part of the truth of God's realm. The student that gets hold of this significance learns much more than facility in the manipulations of processes or the application of principles. He gets some-

thing that makes his life richer and better and his mastery of the subject more complete.

Third: There can be no true culture for a man that does not work, that does not put his cultivated powers to some useful service: and here there must be such degree of mastery over the chosen profession or business as will result in a special skill and dexterity—a doing of some one thing better than others can do it. A man expresses himself through his work, and whether he will or no, he thus discloses to all who know him his own peculiar qualities. It is this intensity of application, this concentration of purpose and directness of aim, that gets the world's work done. Here in early years the engineering student has the advantage of the student in arts. Study for knowledge's sake may be stimulating to the few, but for the many there is needed the goal of a special calling to secure the close application that results in ability to concentrate one's energy to the attainment of a certain end. But here again comes a danger, that of too early, or over, specialization, and the following of short cuts to professional life that are advocated by some who, in the eyes of the world as well as in their own, have been eminently successful as specialists. Whether these can be called men of culture of the highest attainments is another matter. The extreme specialist may be supreme in his own line of details, but may fail when there comes up a question involving the relation of his specialty to other things. Even within his own domain, his conclusions will be modified by his general knowledge and experience. All one-sided people, whether they be linguists or naturalists, poets or merchants, preachers or engineers, are quite liable to the forming of erroneous judgments. To the few geniuses, whose capacities and powers seem to be abnormally developed, though of limited scope, much is forgiven; but for the average man of the day there is demanded an ability to form good and wise conclusions.

Fourth: In order to form those that are appropriate and correct there is needed, then, breadth of view—a quality that has been expressed by the word poise. A man of poise, of even balance, will see things in their right relations and due proportions; he will weigh matters, giving to each component part its just degree of importance. He will the better understand the motives that underlie other men's actions and the more readily use them to suit his own purpose. He will be more apt to rightly interpret the new movements in the world of thought or action and can seize opportunity for a personal advantage or a larger sphere of service before others see that there is such.

This demands a considerable range of knowledge. Not the close mastery of many lines in all their details, but a fair degree of familiarity with their general phenomena and principles; and there is scarcely any field that will not contribute something to the result. It is admitted at once that the average man is of limited capacity and unable to grasp a comprehension of all knowledge that may influence his life and work; what is pleaded for is such degree of breadth as may be needed to make one of great efficiency in his chosen profession and of most value to himself, not only in a financial way, but also in the sense of gaining a joyful recognition of the worth of developing all the powers that one has.

The value of mathematics and the physical sciences with their applications to technical things needs no discussion here, for these are the engineer's tools; but it is a fair question whether, in our desire to graduate students that can be early useful, we do not place too much stress on technical things to the exclusion of others that give greater breadth of training. We must

not forget that we are educating men for a life; that we must look forward to the time when these young people will be fifty years old, and at the period of their maximum productiveness as workers and of maximum value in society and as citizens.

Engineers have to deal with other things besides materials and physical laws; they must manage men and matters of finance. If they are to rightly influence those whose capital they are employed to expend, they must be able to meet them socially and intellectually, to discuss intelligently matters outside the pale of strictly professional life. Evidence of professional ability and skill is of course first demanded, but breadth of culture creates an added confidence in the wisdom of the conclusions reached and the advice given.

Heretofore much of our engineering work has been concerned with the opening and developing of new country or new business and industrial enterprises. So engineers have found their work away from contact with men. But engineering practice is changing, as conditions become older and more settled, and more and more practitioners find their work in communities and busy centers of trade where they are constantly thrown into close contact with strong and cultured men. Present engineering courses do little to prepare a man for this thorough instruction concerning human nature and human relations. Something of history, economics and sociology should be included.

Fifth: It is not sufficient to form correct judgments only; there must be added a skilful and effective presentation of them in well chosen and fitting English. The ability to do this involves more than training in the writing of compositions, themes, forensics and reports. The cultured man should have a taste for reading the best that has been written in his mother tongue, and for several reasons: The great thoughts of great minds are stimulating and broadening to his own mind; he thereby absorbs a knowledge of words and their shades of meaning; he gains an appreciation of style and insensibly better knows how to form his own; and, not least by any means, he makes of his books friends that are life-long, that cheer and console him under all happenings, adding much to his internal resources for happiness.

The time given to English in our courses is not enough to train students properly in its use and at the same time open the doors to our best literature. It may be said that all this English work should be done in the preparatory school, and it is probably true that the character and quality of the high-school English is better to-day than it has been heretofore. Yet it seems to me that engineering students should have some training of a college grade along the line of literature.

Sixth: To the writer's mind, there is another element of culture that should enter into an engineer's training, viz., an appreciation for beauty. As he has said at another time* the engineer is a designer, and it is important that he should embody his design in artistic form if he is to fulfil his whole mission and please and gratify others by the perfection of his work. The engineering student devotes a good share of his time to the drawing-board, and much can be done here toward the cultivation of this quality by an instructor who possesses it, without lessening at all the amount or force of the technical exercises for which the process is primarily used. There should be, however, something further by way of giving instruction in elementary æsthetics and by opening the students' eyes to what is beautiful in nature.

Seventh: The possession of agreeable manners and tact is another evidence of

* *Proceedings* of the American Association for the Advancement of Science, Vol. 45.

culture. Not merely the conventional bearing of polite society, though this has its value. This alone is but a husk which must cover the real kernel, refined and gentle feeling; and such feeling is the result of moral and intellectual convictions. Manners, then, are not to be taught from a text or by lecture; they rather follow as a consequence from the whole course of training and are crude or refined, just as the character of the instruction makes them. The teacher's personality has very much to do with this matter. If he is of coarse grain, of domineering or selfish disposition, his influence will not tend toward the production of true gentlemen.

And now for the real question—does engineering education tend to produce culture? According to old standards, when men limited culture chiefly to a knowledge of language, literature and philosophy, the reply would be in the negative. However, standards are not the thing itself, only methods of measurement; moreover, standards change. Science has modified and is still changing the ideas of culture that men hold, and this evolution makes it all the more difficult to find a common ground upon which all can stand when considering things concerning it. This much is clear, however, that no one existing course of educational training has a monopoly of cultural methods; nor will the completion of any college course necessarily secure its attainment because of its personal quality. Further, culture is the result of a life, and the most that can be expected of a college course is to open the students' eyes to its real worth, to start them rightly with certain leanings and aptitudes, and furnish them with the means of a continuous growth toward its maturity.

It is maintained that an engineering course can tend in this direction, and that in some of our best colleges, under the instruction of people themselves cultured, it does so tend to-day. Our best engineering courses are stiffer and more exacting both as to time and effort than those in the college of arts, and the resulting acquisition of mental power and the ability to focus it proportionately greater.

The fixed course with its correlated parts and the certain definite end to be strived for are advantageous. The training is a continuous testing and trying of the truth of knowledge, and teaches the student to ask 'why' and to reflect. He gains respect for nature's laws, and learns that his professional success will depend on his ability to work in harmony with her. He gathers a fair degree of knowledge of himself, his strong points as well as his limitations. He acquires a habit of thought and action that leads to further growth. He learns how to adapt means to an end, and within what limits of precision to work that it may be reached with economy. In short, he becomes a trained and educated man, cultured to a certain degree, but with limitations; just as the arts student who has specialized to a like degree in language and literature, with little of science training, becomes cultured, but also with limitations. Let the latter retain his A.B. On the other hand, let it be recognized that the engineering B.S. stands for culture as well, of equal worth and value, though of different kind.

As between the two specialists, I think the advantage lies with the engineering graduate as being on the whole, better equipped for a life of useful service and one that will possess the greater capacity for further development.

As one looks forward ten or twenty years and attempts from present tendencies to forecast the work and social standing of engineers, he must see that the profession will be doing a larger work and exerting a greater influence.

Further, that an engineering training will be more and more recognized as the one best

fitted to lead to positions of an executive nature in connection with industrial enterprises, and in the administration of public works. Everywhere will be demanded expert skill, sound judgment and broad views, primarily because these will be found to be economical. The entire class of men that a recent writer has called 'mattoids,' the ill-trained, narrow and egoistic, will be pushed out because their service is costly.

There are two tendencies in the present-day engineering education that are, in my judgment, opposed to the desirable result. First, a tendency to crowd too much of the foundation work back upon the preparatory school, already overloaded. This Society's Committee on Entrance Requirements has advocated a standard which is high enough. Second, the allowing of technical subjects to crowd the fundamental general ones from the college course, in a vain attempt to do what from the very nature of the case cannot be done, make an engineer by college study. The result of this in some institutions is further seen in too early a differentiation between the various engineering courses; so that, for instance, the civil student knows nothing of applied electricity and the electrical student nothing of surveying, while neither has a chance to acquire a taste for literature.

The whole problem is an involved and complicated one, but there is a way out that must be found if the engineer is to fill the important place that awaits him. One part of the solution will be probably found in a refining of the methods of instruction, so that better results may be reached in the same time. In the end, however, the writer thinks that there must come a deeper sense that after all life is long, that it should be taken with more of deliberation, and that it is the end that is important, rather than the beginning. The feverish rush and haste to be earning must be replaced by a recognition of the real necessity for a full rounded-out preparation if the largest and best service is to be given. Then the student will be glad to spend the one or two extra years in college that may be demanded. The wise student now will do this without its being required.

The Chief Justice of my own State has said, "The spirit of an age is that which makes finally for the happiness of the race. I have absolutely no fear as to the final end of things, nor as to the steps and incidents of evolutionary development. The aspirations, the great universal possessions of a people, can never move them to other ends than their happiness and good. The spirit of this age is commercial enterprise and conquest, and as to it I have an unspeakable conviction that it will, as the spirits of other ages have done, work itself into forms and institutions of beauty and eternal worth to men."

It is largely through the engineer that this is to be done. The finest result requires the most skilful labor; the noblest workman demands the most fitting training.

Herein lies our responsibility!

Frank O. Marvin.

University of Kansas.

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*PHYSICAL CHEMISTRY.**

As I am to deliver in the course of the next few days a series of lectures upon some parts of physical chemistry in their details, I should like to use this educational conference as an occasion for presenting an introduction to my lectures.

I add at once that one of our best modern historians, Ladenburg, in his 'Development of Chemistry in the Last Twenty Years,' sustains that the more and more prominent position of physical chemistry characterizes the development of our whole chemical

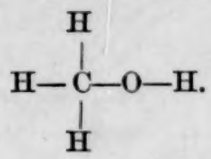
* An address given at the decennial celebration at the University of Chicago, published in the *University Record*.

science during the last twenty years. Let me briefly trace how this physical chemistry has grown, and what it is at present. Allow me in doing this to rely partly on personal observations.

When, as a student of the Bonn University, I studied chemistry first, about thirty years ago, under the guidance of one of the most famous men, Kekulé, chemical science had, according to our master, come to a dead point.

The existence of atoms, though an indirect chemical conclusion, seemed to have been well established, corroborated as it was by the conception of molecules—a conception which rested merely on physical grounds. The details about the mutual relation in which these atoms stood in the molecule either were already known, or in the case of complicated or new compounds a knowledge of them was but a question of time. Thus H_3COH was used to represent the mutual relations of the atoms in the molecule of a simple compound, methyl alcohol; that is to say, it was known that three atoms of hydrogen are held in some unknown way by the atom of carbon, the fourth hydrogen atom is held by the atom of oxygen, and this in turn again by the carbon atom. Yet all such formulas were merely schemes in the mind, or diagrams on paper, and chemistry was looking out for a kind of Newton who might tell us the laws which hold together these atoms in their constellations, the molecules.

You know as well as I that up to the present time this Newton has never come. Yet, only a few years after Kekulé's disappointing prophecy (which, by-the-by, a teacher should never express before his pupils) stereochemistry awoke, and is now a fully developed and well-founded branch of chemistry. By stereochemistry so much at least was attained that, admitting the existence of atoms, we now know to a large extent, not only the mutual *relations*, but also the mutual *positions*, which these atoms occupy in the molecule. H_3COH becomes



That is, the three atoms of hydrogen and the atom of oxygen were found to be arranged in space around the carbon atom in such a way as to occupy the four corners of a tetrahedron, in the center of which the carbon atom lies.

But there we stood, and still stand, since more than twenty-five years, still ignorant of the laws to which their relative position is subordinated, though a recent attempt seems to me hopeful.

Nevertheless, research went on in a way which had very little to do with that architecture constructed by the mind whose building stones are atoms. So, fifteen years after Kekulé's discouraging prophecy, a second child of hope awoke, and this was physical chemistry. It did not appear at once—a scientific branch hardly ever does—it developed as a plant unseen in the shadow, till it felt the sun, and then grew up to be a giant tree.

Some, as Duhem, even say that physical chemistry is a third fundamental science, entitled to be placed between physics and chemistry. Others, like Winkler and Ladenburg, say that, to begin with, we might allow it a prominent place in chemistry and substitute for the division into the two branches, organic and inorganic, a division into three. It will be of interest to add that the University of Göttingen has recently organized the chemical department on this principle. But, apart from all principle of division, which in the end is always arbitrary, because our whole science, like nature, which it reflects, is only one thing, though rather large, we ask: What has physical chemistry achieved?

There are two ways along which a reply to such a question can be given. I might trace in outline the general conclusions, and might speak to you of the laws of chemical change, of reaction velocity, of electro-chemical processes, but I should not be able to do much without the use of a rather complicated formula, which the character of this introduction excludes.

The second way is of a special nature, and I will venture on it, to trace on what lines physical chemistry wrought out its conclusions and what success it met with. The particulars will apply to one of the best known and farthest reaching achievements, to the investigations on osmotic pressure.

Let me begin with that particular attraction for water which we find in some substances very familiar to us, say in ordinary burnt lime. If the lime is kept in a well-filled flask or bottle, which is not hermetically sealed, water from the surrounding air will be attracted by the lime. This will augment the volume of the lime, and the flask or bottle will eventually give away; a tremendous force is thus developed, too large, perhaps, to be exactly measured.

But, on a smaller scale, we may follow up quantitatively the analogous process with sugar, for instance, in a dilute solution, say a 1-per-cent. solution. This will attract water also, as may be shown by filling with the solution a flask, porous, but permeable for water only, and by placing this flask, when well sealed, in water. Then water will enter it till, if the flask holds, a pressure of two-thirds of an atmosphere is attained, as was measured by Pfeffer.

We may generalize and say every solution has the tendency to diffuse into the solvent as if it were attracted by the solvent, and this tendency will produce a pressure if the diffusion is prevented by a membrane. This pressure, for more than a century studied as osmotic pressure, has a well-defined amount; it was known to vary with concentration, with temperature, and with the nature of the substance dissolved, etc., and this was all we knew about it until the way in which physical chemistry worked was applied to it. The result was so transparent that every student may now calculate readily for any dilute solution what its osmotic pressure is; for all may be summed up in this one expression:

$$P = 0.08\ CT,$$

with P, the osmotic pressure in atmospheres, T, the absolute temperatures, C, the concentration or number of gram molecules of dissolved substance in one liter of the solution. The above value of the pressure for a 1-per-cent. sugar solution is, at once, got at by this formula. Let me only insist on the different way in which physical chemistry works as compared with stereochemistry. Physical chemistry does not seek the solution of problems by trying to reveal the constitution of matter, but it works out between measurable things relations to which the calculus may be applied.

This is not all. Looking upon the tremendous work which atomic chemistry has achieved, one must acknowledge that in research relatively little up to the present has proved of value as to what most interests us, the problem of life. Quite the opposite can be maintained with the lines followed up in physical chemistry; and even ten years ago, I used an occasion like this at Utrecht to point out the large part which this osmotic pressure, the laws of which physical chemistry revealed, plays in physiology.

I could indicate the result of many a physiological investigation, pointing to the fact that osmotic pressure is a fundamental factor in the most different vital functions in plant and animal existence. According to de Vries, it regulates the growth of the

plant; according to Daudres it regulates the functions of the blood; according to Mussart it regulates some functions of the human eye as well as the life of the most deadly infectious poisons, like the typhus bacilli.

Since then literature on the same subject has appeared which might fill a new and most interesting volume, in which the most startling fact up to the present would be the fact realized here by that splendid discovery of Professor Loeb, that the act of fertilization in lower organisms, as sea urchins, may be substituted by a given increase in the osmotic pressure of the surrounding medium.

And I may well quote in conclusion his summary that: "At no time since the period immediately following the discovery of the law of conservation of energy has the outlook for the progress of physiology appeared brighter than at present, this largely being due to the application of physical chemistry to the problems of life."

J. H. VAN'T HOFF.

PSYCHOLOGY AND THE MEDICAL SCHOOL.

IT requires only a minimum amount of consideration for a person thoughtful of the matter to recognize that in the most essential meaning of the proposition, psychology is the most fundamental of all the sciences: psychology discusses the mental processes whereby all perceptible nature is perceived. As long as men continually and of necessity study each other, subject and object alike in modes of consciousness, that body of related facts and principles concerning mind will remain basal, and, consciously or unconsciously, universal. Chemistry, for example, treating of the composition of matter, arrives at its analyses only through mental processes which it is the business of psychology to explain and to facilitate. Astronomy tells us of the planets and the stars, but the astronomer who is consciously or unconsciously nothing of a psychologist may readily deceive not alone himself, but the scientific public, as has happened more than once. To the psychologist no longer 'seeing is believing,' as the ancient adage runs, for the nature of man unfolds itself apace and shows fold within fold undreamed.

Yet on other grounds than these, which are theoretical and philosophic, lies the interest of the science of psychology to all who have the opportunity to intelligently learn its principles—men and women value it and usually become more or less absorbed in it because it describes themselves, and, ever more successfully, attempts to explain what is and must ever be the most regarded of subjects to every agent, namely himself, as individual and as social unit. The biologic egotism implanted deep in every soul sees to it inevitably that all one's life, whatever the social status or the life-pursuit, that soul shall study continually itself, with however apparent indirectness or however elaborate the social system of real or hypocritical altruism may be. Indeed, altruism has nothing to do with the deeper aspects of the interest in question, this interest being beneath all altruism, in the organic mechanism. The degenerate criminal and the flower of ethical manhood play alike on the same fragile instrument, one miserably and the other with far better harmony; this instrument is consciousness and the changes that it manifests are constant in one only thing—it is I, I, I, the type, the sum. It is chiefly on this account that psychology is an interesting science.

But besides being the basal and an eminently interesting science, psychology is a sound science, 'new' but soundly scientific, a thoroughly self-reliant and deep-set department of systematized human knowledge. In substance older than Thales, known as methodical since Aristotle, yet

every century has added alike to its mass and to its dignity as a science, every year of late has better shown its interpenetrating relations with other topics of learning and dug its foundations ever deeper into the rock-based ground of human knowledge. From one point of view the science is sometimes at a relative disadvantage because it merges in its upper rarefied air with metaphysics and 'divine philosophy,' so that some have left it in their eagerness to loiter on the paths less fixed, less final; let us hope their wings will bear them there. It is as if the astronomer should become a dreamer wandering among his stars, hoping thus best to make out the almanac or to satisfy the yearning curiosity animating all men on the humble earth. In psychology as in astronomy it is the workers who count most, men and women to whom a sphygmograph or a chronoscope is an instrument as dignified as the pen which writes without experimental mediation the reasoned imaginings of the seer.

But there is a class of persons who harm the fame and progress of psychology among the mass of average men, and the injury these do is devoid of any sort of recompense. These are the irresponsible multitude who know little or nothing of science and who have no desire to know, quite, nay more than, satisfied if in one or the other of a host of shiny masks they can fleece a willing public either of their dollars or their sense, succeeding ordinarily in abstracting both at once. These are the 'mental healers,' the 'metaphysicians,' the 'Christian scientists,' the 'psychologists,' the astrologers, the palmists, the 'mediums,' and their ilk, all of whom more or less of the public consider in some way or other allied with the science of psychology. Mysticism of this grade is for the scientific student an absorbingly interesting topic of research, leading him meanwhile to wonder and to pray—wonder at the shallow deeps of the human mind, pray for the day to hasten when education shall be for all men, share and share alike, each according to his needs and his ability. Psychology bears the brunt, necessarily, of many a false system and falser creed whose names any who reads the signs along the pavement may learn full easily, the list above containing some of those most known. But the science of psychology looks on with serenity, complacently expressioned with the consciousness that phenomena like these are part of its own subject-matter, to analyze and to explain. It is the public who are fooled and who wish to be, and them in turn, as the loci of ever-recurring phenomena, psychology studies and characterizes. Deplorable indeed is the ignorance of the mass of men, even in America, concerning this science. To many the name means psychical research, to others some phase of mental healing, to others something, which, chiefly because spelled p-s-y-c-h instead of s-i-c-h, can never come within their knowledge, to others, finally, nothing whatever for they never heard the word.

But even among the educated, too often the notion of this science is such that it is not valued at its proper worth, because its *practicality* is too little understood. Here is suggested one of the future duties of the psychologist—it is time that he demonstrated to the world, the great world as well as to the lesser world of letters, that psychology is properly a very practical science, thoroughly useful to the average man. It is on this basis alone that it is worthy of life. A science seemingly should not be classed with belles-lettres or with pure philosophy, as the means of satisfaction of man's eagerness for abstract knowledge or for an understanding of the æsthetics of existence. These things may in one sense be more than science, but they are at the same time in a different sphere and incomparable. The

progress of the race depends not on the products of pure reason; did it so depend Plato and Kant would be more than names to the millions of our countrymen, and this splendid Greek of so long ago would be the world's idol in the place of the men who have *done* things and who *do*. Men at large desire science rather than philosophy, for to them rightly the sciences mean progress in living ever better and more easily. Utility is and must remain the unchanging standard by which a science, like all other things in the last resort, is measured. This fact many psychologists apparently have overlooked, so brief at present has been the time since their science freed itself, by working out the outlines of its proper sphere, from the conservatism of philosophy. Right well and exceedingly is psychology fitted by its subject-matter to demonstrate and then to enlarge its human usefulness. By necessity of the 'struggle for existence' (so inevitably often emphasized in every sociological discussion), all men are psychologists and not less so that only one in a million thinks of himself as such. Somewhat in proportion to his practical success as a psychologist, consciously or unconsciously, in proportion, that is, to his knowledge of his fellow-men and of himself, does a man or woman succeed in life. It means more than anything else this wisdom in human nature. The schoolboy knows his teacher more or less well as he recites to him or seeks to win his favor; the candidate for the doctorate very likely has studied the faculty only less than his research, and at the time when each word counts he uses well his information. The merchant studies the man from whom he buys his stock, and doubtless still more carefully the 'market,' which is only a convenient term for the balance of the hour between merchandise and men's desire therefor. The business man depends even more largely on his knowledge of human nature in his dealings with a public which is always more or less suggestible. The actor studies humanity that he may imitate it, the conjurer that he may deceive it. The judge in court is preeminently a practical psychologist, the policeman less so, while the value of the jury system and the virtue of a particular juror often depends directly on the jury's rightly weighing the human probabilities of motive and of action. Such values are practical and real.

But more than others, if possible, 'professional men' should be good, that is, practical, psychologists. They should understand completely the psychophysical nature of men and women to be successful. The clergyman must preach the Gospel, but he must preach it both in the spirit of the times and in the spirit of his hearers—not preaching hell-fire when the advancing rationality has put hell-fire forever out and named it cruelty; not preaching sermons two hours long when men in general might fairly be satisfied with half-an-hour. So too the lawyer (and in a perhaps even larger degree) must be a psychologist, whether he knows it or not, if he is to please his client and enlarge his practice. He must know well the relative value in a particular man of feeling and of cognition, must value rightly his client's strength of will and perhaps his cleverness under cross-examination. In every phase almost of the lawyer's professional life his knowledge of himself and of man in general forms his chief stock-in-trade. The lawyer's success largely depends on his acquaintance with man's mind and how it works—his science above all is the 'science of the soul.'

To medicine, the third of those pursuits long classed as professions, we now turn to see how, in a more immediate way than has so far been considered, psychology is naturally related to it. Like other men, the physician is of course a practical psychologist so far as his native instincts lead him

to become so. For reasons, however, which will be pointed out below, the medical man needs a more exact and systematic knowledge of the relations of the human mind than the hereditary common wisdom of the race provides him with, while at the same time his opportunities for acquiring this knowledge at present are either entirely lacking or quite impracticable for the average practitioner. It is a fact that the men who, for the public benefit, require the largest amount of insight into mind and its relations with body, have had thus far the least convenience for acquiring it. This condition is probably a relic of that same ancient fallacy so very frequently encountered everywhere, that material objects (here the tissues of the body) are more real and more important than things which are immaterial, ideas and emotions and the determinations of the will. Yet most old men and women would tell you that these latter things had influenced their lives far more than matter of any sort whatever. For every person maimed by a material accident a dozen are maimed by some one's will or emotion or idea.

The physician needs some direct acquaintance with the science of psychology, because, in part, he is properly the self-elected teacher of the public, and to every teacher, of whatever sort, psychology is by reason of its nature necessary foundation-knowledge; to argue otherwise is sophistry, convincing to none. The average physician, that is to say, most physicians, are not teachers of the public in hygiene, physiology and general prophylaxis to half the measure that they might be, some from inability, some from thoughtlessness, some from 'inertia,' some possibly from indisposition so to do. But this duty of the medical man is a privilege and its compensations out of proportion to its costs. Herein lies the general affection for the old-time family doctor, the most contented and best requited of his profession, the friend and confidant rather than the hireling of his neighbors. Practical psychologist that he was, when he entered a house, patient and household at once felt better even though death were near.

In ways, however, more immediate to his cases than in this position as medical educator to the public does the physician need to know the principles of modern psychology in a broad meaning of the term. He requires it because always in his practice he is concerned with living and social organisms who invariably are compounded of *both* body and mind. As regards the wholly obvious necessity of acquaintance with the normal mind for the many medical graduates who pay chief attention to mental and to nervous diseases, much might be said, although little will be, here. Even these, alienist and neurologist (although usually versed more or less, late or soon, in the substance of empirical psychology, while some are competent and even distinguished psychologists), even specialists in the mind, have at present no adequate opportunity to learn the substance of the science in a thorough systematic way. Many of our distinguished alienists have enjoyed a general college education and some have been led by the psychology learned meanwhile to 'specialize,' when their medical degree was acquired, in the diseases of the mind. But these educational privileges are relatively infrequent and with our present system of college education must remain so some time, most medical schools being not yet, by probably many years, post-graduate institutions. Yet insanity appears, by reliable statistics, to be on the increase; and to meet the certain demand for the care and proper treatment of these patients, a larger proportion of all medical graduates will, by economic principles, devote their attention to this most important branch of therapeutic science.

To meet the necessities of this class of practitioners alone the establishment in the medical schools of courses in normal medical psychology is urgently demanded. To graduate a psychiatrist without this knowledge is like pretending to qualify a general practitioner without teaching him physiology. Exceedingly few of the graduates, eager to get at actual cases, and the best of them soon enough crowded for time, will or can take up the long-drawn unadapted psychological courses in the universities and colleges, nor, did they desire to do so, would funds be often at their disposal, the debts of the young doctor being often, as it is, quite sufficiently appalling to the young man anxious then to earn as fast as possible. For the sake of these men alone, then, courses in medical psychology should be provided where alone they will be studied with the splendidly productive medical-student eagerness and attention.

The education given, or rather sold, to the medical student seems in general, however, too grossly materialistic, too somatic. He learns but one side of this two-sided story; from the first year to the fourth, from the dissecting room to the gynecological or otological clinic, the routine student sees and hears of muscles and bones, and viscera, sense-organs, nerves and vital fluids, but little, unaccountably little, of that other aspect of men and women which to these very men and women is their life, while these other, these organs, are but needful instruments of that life's attainment. And their point of view, it need not be said, is also that of philosophy; shift it, and illogical confusion follows. The layman cares little or nothing for his stomach's condition so long as it gives him no pain and takes good care of what his will and his appetite lead him to supply to it. The woman in search of a happy family life thinks seldom of her reproductive mechanism so long as it gives her healthy children whom she can love. There is something besides cell-built tissue for the gynecologist in charge of an operative case to consider when of two women, alike in vigor, who undergo identical ovariotomies, for example, one goes in three weeks from the hospital a new woman, cheerful, capable and happy, while the other becomes an hysteric wreck never perhaps to equal her former self in happiness or in health. As every surgeon knows, such differences are met continually and they puzzle him. Why is it that present medical education takes no account of the principles underlying phenomena like this? So far as the student is concerned, the course, four years or three years long, quite ignores in general the emotional and temperamental factors which in one way or another, directly or indirectly, less or more, enter into almost every chronic case and into many of the acute cases which the general practitioner is called upon to treat. Instead of striving to teach the student what conditions underlie mental habits and idiosyncrasies, medical instructors are now content practically to ignore them, regardless of possible great benefits to come from their study as psychological data. Too often is the medical man the most materialistic-minded member of a community, when his view should be much deeper, into the controlling forces of life. This is the natural outcome when in a long medical course no part of the individual is presented to the student except what he can feel with his hands or see through the microscope. Yet how commonplace is the assertion that the man, the real man or woman, is not his or her body, but the will, affections, habits, character, of the individual, while (what is more immediate to our argument) these same aspects of consciousness are often the direct molders or destroyers of disease and, as one side of an inseparable psychophysical organism, have more control or influence over the functions purely somatic

than the average practitioner of medicine appreciates. Not mind controlling body nor body controlling mind, but both together always sensitive to the stimuli of a common environment combined into the actual individual.

The conventionalized and systematized knowledge of conditions thus important in treating disease is a portion of psychology. Crude indeed are its names and its conceptions as crystallized in names compared with the empirical reality, but it is of necessity that they are crude and only representative or symbolic that a science may be constructed and discussed. A new medical psychology adapted to its special usefulness would very soon develop a terminology of its own, fitted to the case. The term temperament, for example, vague and little really explained by general psychology, would, as a subject in medical psychology and in the minds of physicians, soon take to itself more explicit meaning, adapted to its use. By this natural process of specialization of sense medical psychology would suffer relatively little from that variation in meaning among different writers, from which general psychology (from the abstract nature of its matter) suffers much misunderstanding within itself. By thus fixing the meaning of certain terms, and that probably in more or less direct relation with concomitant somatic conditions, medical science would do a distinct service to empirical and physiological psychology, and more substantially than any dictionary could do it.

A normal medical psychology, to be at once scientific and comprehensive of the field, would very likely set out with a relatively brief exposition of genetic and of empirical psychology, discussing thus in certain and uninvolved terms the classification of mental processes under cognition, feeling and will in the ordinary elementary way. The more physiological in nature the treatment of this portion of the subject, the better would the medical student connect it with his knowledge of the body gained earlier in his course. With these principles of the science as a basis and point of departure into allied branches of science, the topics more immediately practical to the physician might be taken up in a series as much unified logically as possible. In this, the immediately practical portion of the work, the field would naturally and necessarily spread out somewhat so that it would be important to enter briefly at times into anthropology (anthropometry especially, perhaps), criminology and certain departments of biology, notably that regarding the heredity of mental traits. Still, obviously, the greater part of the discussions would lie strictly within the domain of psychology as it is empirically studied to-day, using for its own purposes, as it does, the products of many different varieties of scientific research.

The topics of medical and surgical importance which such a course might examine into with benefit and interest are very many, as any medical man will recognize. They are subjects such as those below are examples of, placed here almost at random so far as order is concerned, namely, temperament, mood, idiosyncrasy, pleasure, pain, emotion, anæsthesia, hypochondriasis, dynamogeny, will power, sleep, subconsciousness, habit, sexual, racial and epochal differences, suggestibility, hallucinations and other scarcely abnormal phenomena of the sense-organs and their neural centers. To mention only suggestibility, the habits and sexual psychology out of this list will perhaps be sufficient to show how important a course treating of such topics might be made by a competent man. Continually is suggestive therapeutics taking a larger share in the treatment of certain chiefly psychical diseases, and to explain its nature, uses and limitations is to equip every physician

better than now he is equipped. Again, who could exaggerate the importance of the habits in causing misery and in curing it? And lastly, in these days sex is taking ever more rapidly its proper place in the science of 'things as they are,' monstrous often to the layman, and properly, but to the physician natural and preeminently important. A widely related discussion of such topics as these, it seems to the present writer, would furnish to a medical student of the necessary mental development, facts and relations as important for his professional purpose as most of those which are at present taught him. Such a course would do much to supply the lack of knowledge of man's dual nature, which, as has been sufficiently suggested, usually obtains in the average physician. This would be its chief value in a medical curriculum, but not its only one. It would also supply that needful amount of psychology which would allow the usual courses in psychiatry and neurology to be better appreciated and more completely understood, especially of course as concerns those conditions, such as hysteria, neurasthenia, paranoia, dementia paralytica and the rest in which a purely 'mental' aspect is often or always prominent. It would help to make such conditions really understandable so far as their description at least is concerned, whereas at present, the ideal disturbances, notably in paranoia (very commonly met with), are far beyond the understanding of the medical student, for lack of acquaintance with the theory of normal ideation. It would make such conditions seem like scientific problems pressing for his solution rather than like mere arbitrary sets of ill-understood events which he must learn by rote and the memory of which, when occasion offers, he must mechanically apply.

In form such a subject might easily be comprehended in a course of weekly lectures during the former half of the fourth year of the medical curriculum, either elective or required. It need involve of course no laboratory work, nor would this be fitting, sufficient demonstrations being used to illustrate certain points and to increase still more the students' interest.

It is not difficult to understand why something of this sort has not already been introduced, instruction which would impart the suitable product of the progress in these directions in the last few years. The progressive spirit of the various medical faculties has been employed of late, for the most part, in establishing departments of bacteriology, pathology and experimental physiology, and in enlarging various modes of clinical experience. These have now in all schools of the first class become flourishing departments, demonstrating well their importance. Thus other fields have naturally been neglected in these new years of the sciences of the bacteria. It seems time now that the growing energy of the medical schools should look around more widely and realize, with practical benefit, that if emotions cause at times disease as well as the bacteria, so it is equally important that the conditions of the one should be taught the student as well and as certainly as those of the other. Not at once as a universal means of progress will this enlarged and more scientific mode of viewing every patient be shown the student of the medical sciences, but assuredly it will come, and in some form not wholly unlike that which has here been all too rudely sketched and for reasons similar to those here pointed out. Such a course by a psychologist of wide interests and information among branches of learning of allied aims, a medical man if possible, would seem to be worthy at least of trial in every medical school whose avowed purpose it is to provide its graduates with a knowledge of men as they are, and not

alone to furnish them with the science of one-sided and therefore false somatology.

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*THE BOTANICAL WORK COMMITTEE.**

A Blue-book (205) of 247 pages has been issued containing the report of the committee on botanical work and collections at the British Museum and at Kew. The Committee was appointed by the Treasury on February 1, 1900, 'to consider the present arrangements under which botanical work is done and collections maintained by the Trustees of the British Museum, and under the First Commissioner of Works at Kew respectively; and to report what changes (if any) in those arrangements are necessary or desirable in order to avoid duplication of work and collections at the two institutions.' The chairman of the committee was Sir Michael Foster, M.P., and the other members were Lord Avebury and Mr. F. D. Godman, representing the Trustees of the British Museum, Mr. S. E. Spring Rice, C.B., Mr. H. A. D. Seymour, C.B., Professor I. B. Balfour, Queen's botanist for Scotland, Mr. F. Darwin, reader in botany in the University of Cambridge, and Sir John Kirk. Mr. B. D. Jackson, secretary of the Linnean Society, was afterwards appointed secretary to the committee. The report opens by pointing out the essential differences between the Botanical Department of the British Museum and the Royal Botanic Gardens at Kew.

The former is a collection of such objects as can be placed in a museum, and is not concerned with the applications of botany; whereas the latter, besides constituting a public garden, is an organization which gives assistance to the government on questions involving botanic science in all parts of the Empire. Both possess herbaria with libraries attached; and the two herbaria, though each possessing some special features, are to a very large extent duplicates of one another. This duplication of specimens entails, of course, a duplication not only of housing room, but of scientific work and of the scientific staff; and the existence of this waste is a strong *prima facie* argument against the maintenance of the collections in their present form. The report observes that the question of amalgamating the two collections has been considered by committees again and again, and after considering the arguments urged on both sides, the Committee, with the exception of Lord Avebury, pronounce in favor of their union. Their report discusses at length the possible methods of union, the relative convenience of Kew and the British Museum as sites, and the question of constituting a special advisory board, on which the Trustees of the British Museum should be adequately represented, in the event of the removal of the greater part of the British Museum collections to Kew. The recommendations on these points are summed up as follows:

(1) That the whole of the botanic collections at the British Museum now administered by the Keeper of the Department of Botany under the Trustees, with the exception of the collections exhibited to the public, be transferred to the Royal Botanic Gardens, Kew, and placed in the charge of the First Commissioner of his Majesty's Works and Public Buildings under conditions indicated below, adequate accommodation being there provided for them. (2) That a board, on which the Trustees of the British Museum, the Royal Society, and certain departments of his Majesty's government should be directly represented, be established in order to advise on all questions of a scientific nature arising out of the administration of the gardens, the powers and duties of the

*From the London *Times*.

board, its relations to the First Commissioner and to the Director, as well as the position of the latter and the functions of the gardens, being defined by Minute of the Lords Commissioners of his Majesty's Treasury. (3) That the illustrative botanic collections now publicly exhibited at the British Museum be maintained, and, so far as it is possible and expedient, enlarged and developed with the view of increasing popular interest and imparting popular instruction in the phenomena of the vegetable world, and be placed under the charge of an officer of adequate scientific attainments, responsible to the Director of the Natural History Departments. (4) That upon the transference of the botanic collections from the British Museum to the Royal Botanic Gardens such arrangements be made both in respect to the accommodation of the collections and the staff administering them that they shall fully serve the purposes which they have hitherto served. (5) That the botanic collections consisting of fossil plants, now in the charge of the Keeper of the Department of Geology in the British Museum, be maintained for the present under the same conditions as heretofore. We desire to express our warm appreciation of the valuable services which have been rendered to us by the secretary, B. Daydon Jackson, Esq., secretary of Linnean Society. Not only has he performed his duties as secretary with great zeal and ability, but also throughout the inquiry we have repeatedly derived great assistance from his very intimate acquaintance with the botanic collections under our consideration, as well as from his wide knowledge of botanic science and literature.

This report is not signed by Lord Avebury, who cannot concur in recommending a removal of the British Museum herbarium to Kew, for the following reasons:

It seems, no doubt, at first sight, an anomalous arrangement that there should be two national herbaria; first, on account of the expense; and, secondly, because botanists in some cases have to consult two collections instead of one. But the evidence shows that the saving of annual expense through the suggested fusion would be small, and that the initial outlay for building, cabinets, etc., would be heavy. The alleged inconvenience seems to me to be exaggerated and affects only a few of those engaged in systematic botany who are thus obliged to consult two herbaria instead of one: while, on the other hand, to those engaged in other departments of botany, the existence of the two herbaria is an advantage. I deprecate the proposals contained in the majority report for the following reasons: (1) The British Museum is the greatest museum in the world, and is justly the pride of the nation. To dismember it, by depriving it of so integral a part as the Botanical Department, would be destructive of its unique character as a fully representative museum, and specially of a natural history museum; would be vehemently opposed by many, if not most, British botanists, and, as it seems to me, would be a great injury to science. (2) To London and country botanists the British Museum is much more accessible than Kew. (3) The plan proposed would separate the fossil from the recent plants. (4) It would involve the creation of a new board. If, on the other hand, Kew Gardens and the British Museum were brought into closer relations, as recommended in the report which I have signed in conjunction with Mr. Seymour, several advantages would result; for instance, the officers of the Museum would have access to the living plants; while those of Kew Gardens would have access to the British Museum library and the collection of fossil plants.

Lord Avebury and Mr. Seymour also ob-

ject to the constituting of an advisory board. They say:

If we were starting *de novo* it seems obvious that the whole of the national biological collections in and near the metropolis would be placed under one management. The Trustees of the British Museum are established by statute, and are partly selected and partly *ex-officio* members, more than one-third being high Ministers of State. Those to whom the active duties of management and superintendence are entrusted possess special knowledge in the various subjects illustrated by the collections, and they appear to us to be more fitted both by their experience and their position in the scientific and cultured world to be the governing body of the amalgamated botanic collections at Kew than any other that can be built up in their place. If those collections form part of the British Museum, the Director at Kew would become an officer of the Trustees in the same manner as is the Director of the Museum at South Kensington. It is true that in the report it is stated, 'Were Kew placed under the Trustees of the British Museum, unless their control were a merely nominal one, a thing in itself most undesirable, the demands of the Colonial, India and Foreign Offices on the resources of Kew would be subject to the control of the Trustees, a situation fraught with difficulties and dangers.' This assertion does not appear to us convincing. No example is quoted of these difficulties, the dangers are not indicated. It is far from clear why one controlling authority is more likely to produce them than a lay authority and a scientific authority with an advisory board interposed as a buffer between them. * * * We feel that the introduction of a new board such as is proposed is at least as likely to produce friction and difficulties as the present authorities, and will tend to weaken responsibility, and on this account, as well as because we do not attach much reality to the 'difficulties and dangers' which would arise from the substitution of the control of the Trustees of the British Museum for the present control, we dissent from the second recommendation of this report.

THE FUNCTION OF THE STATE UNIVERSITY.

Wherever in this paper the word university occurs, it means State university; wherever the word college is used, it means a private or denominational institution. Let me describe the function of the State university as it appears to me.

I. It should be *within:*

a. Non-partisan, but patriotic to the State and to the Nation;

b. Non-sectarian, but religious;

c. Free as to tuition in all departments, academic and professional;

d. Every inch a university.

a. While the obligation named first binds every institution of learning in our country, it binds the State universities in a peculiar degree. Their foundations are federal land grants. The funds for their maintenance come from their respective commonwealths. In the highest and broadest sense they should be nurseries of patriotism, but they should shun partisan politics as they shun death.

b. Non-sectarian, but religious.

The State universities have not yet realized their opportunity for developing in students a life that is religious and yet not sectarian. Freedom from denominationalism is apt to be construed as license to subordinate unduly religion in education. No good reason appears why the universities should not each maintain one professor at least to lecture upon sacred literature, natural religion and practical morals, and to serve as chaplain of the students. If, unfortunately, the law or Constitution forbids such teaching at public expense, an appeal should be made for an endowment

by private benefactions. What a blessing for a long time has Dr. Peabody been to Harvard. Such a man ought to be at every seat of higher learning.

Moreover, why should not a large State university maintain a department of theology, without which it is not complete and which does not belong necessarily to any denomination. In Germany, in spite of an established church, theology is non-sectarian. Men of all creeds go there for training. Why should not our American State universities show that ethics, religion and even theology of the highest and best type may be divorced entirely from denominationalism?

c. Free as to tuition in all departments, academic and professional.

This proposition ought to be established by the mere statement that in every commonwealth the university is the head of public instruction, which is free up to the higher learning and ought to be free there also. The reasoning that people have indulged in as to free tuition is very curious. In early times the doctrine was preached that schools should be maintained at public expense, but should be limited to the elements of learning—reading, writing, arithmetic, geography and United States history. A little learning the public might give the individual, but no more. After strenuous opposition, this doctrine was established in New England, in the Middle States, in the West, and finally in the South. Then came the second step forward, in which in many places high-schools were smuggled in. In Kansas City, for example, the first high school, now one of the best in America, was for years maintained rather surreptitiously. Later the people throughout the union came to the belief that a chance at secondary education also, without charge for tuition, was due from the commonwealth to every soul on its soil; but it was still argued generally that college or university training should be paid for by the individual. Not long ago, some Western States reached the third stage of progressive belief that free instruction should be given through the college of liberal arts, but that professional training should be paid for. In the process of evolution, however, the fourth era is near at hand, in which it will be recognized, I think, that the discrimination between academic and professional instruction is wholly specious. If it be granted that the State owes to every soul on its soil a chance at free instruction through the college of liberal arts, by what legerdemain of logic can it be denied in medicine or engineering? In these so-called professional courses perhaps half the studies are academic, and the other half are applications of the academic. Is it reasonable for the State to teach a man freely physics, chemistry, mechanics, drawing and mathematics, but refuse to teach him freely their applications to engineering? Should one learn at public expense, such academic subjects as physics, chemistry, neurology, embryology, anatomy, histology, physiology, physiological chemistry and bacteriology, but learn at personal expense their applications to medicine? All such reasoning is to my mind artificial. It is said that law, medicine and engineering are gainful pursuits, and, therefore, the beneficiaries should pay for training in them. The argument is not worth refuting, but, if it were, it might be pointed out that bachelor of arts is a gainful degree. Moreover, academic graduates are not more useful to the people than are lawyers, physicians, pharmacists, dentists, engineers, etc., of superior quality. As soon as you admit that the commonwealth must furnish its people free instruction in any degree you are compelled to admit that it must furnish free instruction in every degree and in every useful form. But the same argu-

ment, it is said, might be advanced for free clothing or board or books. To my mind this does not follow at all, but if any man will demonstrate that they should be furnished in any stage of education, it would be easy to prove that they should be furnished in every stage thereof and in every useful form.

It is questionable whether, in view of the superb training at Harvard, Massachusetts is bound to found a free university, but in my opinion she is bound to give her citizens that desire it and are prepared to receive it free instruction in some accessible university of high rank. Whether free tuition should be extended by one State to citizens of another is a question that I will not now discuss. Those who, like the writer, exalt the Nation above the State will favor it.

In closing this division of my subject let me say with emphasis that free tuition in any department without high standards of admission and of graduation is akin to crime.

d. Every inch a university.

There is danger that through eagerness to take in new territory, to swell enrollments, and to provide instruction for special classes, some of our universities may forget that to deserve richly their titles is the highest obligation they owe to the people. Policies of expansion and adaptation are sometimes commendable and occasionally are forced upon us by circumstances, but they take money and subtract from the energy due to higher teaching. Never should they be allowed for a moment to obscure the main purpose, which is to be from circumference to center a great university. Particularly objectionable is the tendency too often exhibited to swell enrollments by adding professional schools in the nearest metropolis. These *morganatic* unions rarely bear good fruit. A university is much more than a college or an aggregation of them. Its great work is graduate and professional studies based upon an academic degree. To attain this end is far harder when the work is not concentrated on one campus.

II. The university *without* should care for the State and should serve as a buttress to a National University.

It has been preached strenuously that the State should care for its university but scarcely has the idea been broached that the university should care for the State. It is possible to do this in a variety of ways, in material, in social, in political and in spiritual things. The possibilities in spiritual things have been discussed in the second paragraph of this paper. What can a great seat of learning do for the public good in other directions?

a. Through the College of Agriculture, or in conjunction with it and other public agencies, it should look after the material welfare of the people.

The loftiest learning should not scorn to help men in their material interests. If in its laboratories a dietary can be discovered whereby the fattening of swine is made cheaper to swineherds, the university should promulgate that dietary. The Babcock Milk Test, discovered at the University of Wisconsin, has been a blessing to dairymen in all the world, and almost as beneficial to another class of husbandmen has been the discovery in the University of Missouri of a method of inoculating cattle against Texas fever, whereby the mortality in blooded animals carried south has been reduced from ninety to less than eight per cent. Our colleges of agriculture have devised better dietaries for domestic animals than the wit of medicine has yet invented for growing children.

Expeditions have been sent out by our universities to measure accurately remote water power and to survey routes for transmitting it electrically to railway stations; to measure beds of coal and test their ther-

modynamic values; to measure beds of cement and quarries of stone and try their quality; to collect flora, fauna, rocks and minerals; and for other useful purposes. The results, carefully tabulated, have been widely distributed. Diseases of animals and plants have been held firmly in check. What has been done shows what may be done for things material by the scientific skill of universities. But what has been accomplished has been mainly along the paths prescribed by the United States, in the Hatch Act, establishing Agricultural Experiment Stations. Except under federal leadership, our universities have not done very much, I fear, for the material welfare of the people, when one considers the immense possibilities.

b. In collaboration with State boards, bureaus and commissions, the university should look after social and economic conditions.

How many States can point with pride to their penal institutions—their jails, penitentiaries, reformatories, almshouses, tenement houses and asylums? Yet the university of each commonwealth perhaps maintains a chair of sociology. On the campus are students from every county. In their summer vacations they could visit every reformatory and eleemosynary institution, reporting accurately its condition. A judicious publication of the results, with a statement of fundamental principles, would lead often to radical reforms in the treatment of the criminal and defective classes.

No State is without municipal problems and few can boast of a rational system of taxation. Why should not the department of economics take up these subjects? If the professors understand what scientific taxation is, why can they not apply it wisely to prevailing conditions? The wisest teaching of political economy in municipal problems should be spread broadcast. The Federal Government maintains in every commonwealth an Experiment Station to find out what is wise in agriculture and to disseminate among the people the knowledge gathered. The departments of sociology and political economy ought to be experiment stations after their kind in the full meaning of the Federal Government, and the university should not begrudge the cost of publishing and distributing among the people whatever information may be necessary to enable them to adjust wisely their systems of taxation, to solve municipal problems, and to improve the condition of their penal institutions, reformatories, asylums, almshouses, tenement houses, etc. It is the function of a university to investigate, to teach and to publish.

A painstaking study of the State laws, in the light of the broadest learning and in comparison with other codes, if embodied in timely publications and spread broadcast, would not be without good results anywhere. The achievements of David Dudley Field in this direction are well known.

The early history and archeology of every State is an inviting field for investigation, while the editing of early local writers of the better sort might well employ some of the literary skill of the faculty. A *spicelegium* in some cases it might be, but in every case it would be valuable.

The departments of chemistry, sanitary engineering and medicine find a wide field of usefulness in things pertaining to public health: pure foods and drugs, pure water, good sewers, the ventilation of buildings and so on. In this broad direction it is possible by scientific work and by helpful publications to diminish sensibly the rate of sickness and of death.

c. In cooperation with boards of education and the State Superintendent the university should build up the schools below it.

The writer has talked on this subject so often that he feels inclined now to dismiss it hastily. Elementary schools cannot be brought to efficiency, unless there be high-schools to lead them, and high-schools cannot become ideal without the help of a university. The whole system of public education from the kindergarten to the graduate department, and through it, should be strongly knit together. This principle is accepted universally, the chief discussion being about instrumentalities. My own experience causes me to place high value upon examiners of schools appointed by the university. The examiner should be an instructor or assistant professor of pedagogy, and should lecture sometimes on the campus. In large States it might prove convenient to have an examiner for town high-schools, another for rural schools, and a third for elementary schools. The examiners should all be extension teachers of practical pedagogy. Their function is not so much to examine as to build up. If the university will pay for the cost of this service, the money will come back two-fold. As an example of what may be done by an institution for the schools below it, let me point to the University of the State of New York. Few universities could engage in all its manifold work, but according to our means we should adopt its best methods. Traveling libraries and galleries and extension lecturers as well as examiners of schools are educationally important means of grace.

Moreover, the university is not without obligation to the private and denominational colleges which, chartered by the State and protected by its laws, teach a large percentage of the educable youth. It is a blunder of the first magnitude to assume towards these colleges an attitude of hostility. One of the best things that we have tried in Missouri is the College Union, consisting of the University, and of every other respectable institution of higher learning. At the meetings, held at each institution in succession, we discuss common problems, talk of common troubles, and help one another to the common end—the uplifting of the people. In spite of provoking opposition occasionally from the churches, any university should be held largely responsible if bad feeling continues between the denominational colleges and itself. Stepping grandly over small animosities, it should remember that, while officially it is the head of public instruction alone, in a broader sense it should be the loving helpful head of all sound education in the commonwealth.

The State university should serve as a buttress to a National University.

Education will not be complete in these United States until we have at Washington a national university with State institutions as its buttresses. Some day our education will conform to our system of government. I for one would not be willing to see institutions of any class enjoying privileges in the national university that are denied to other institutions of equal or superior grade, but close affiliation between the State and nation seems inevitable in education also.

In conclusion let me answer some possible objections to the positions taken in this paper as to the outward obligations.

Should the university invade the provinces of the boards, bureaus, and commissions—the Geological Survey, the Natural History Survey, the Health officers, the Tax Commission, the Superintendent of Public Instruction, and the College of Agriculture and the School of Mines, if, unfortunately, these stand on separate foundations? If the interests of the State are adequately served by others, the university might let well enough alone. Under no condition should it officiously invade the territory of any officer or organization appointed by

the State. But ninety-nine per cent. of the difficulty will disappear if only the university will do the work admirably and let others take the credit. If the purpose be to promote public welfare why should one care who gets the praise? In every instance, hitherto, in the writer's experience, the scientific, philanthropic and statistical departments of the State and the nation have been eager for cooperation, wherever the university has demonstrated ability to do work superbly, and in most cases they have supplied the money. Besides, it is one thing to appoint commissions and quite another to induce them to fulfill strenuously the purposes for which they were appointed. Many a yawning gap of deficiency in public officials may be quietly bridged by the patriotism and skill of the university, which should be the eye of the people, searching in every direction for opportunities to serve their welfare.

Will not the discussion of social and civil questions embroil the university in partisan politics? The most important problems of sociology and politics are not often embodied in State platforms, which usually consist of the national structure with a few more planks lauding one party and vilifying the other.

Do you ask where the money for all this is to come from? False to the core is the idea that the resources of a university are solely for instruction on its campus. The administration has no right to wait always on needed investigations for special appropriations from the Legislature. It should rather assume that in part the income must be consecrated, as need arises, to promoting the public good wherever it can be reached by scientific skill. Ultimately no use of money will pay better, even as an investment of capital. At last, we are not required to do more than our resources permit. It is the spirit that maketh alive. The important thing is for the university to construe its functions liberally and to choose intelligently what can be done now and what should be postponed. Time as well as money is necessary for perfect performance of its whole function.

In conclusion, let me say that the State University, founded by the Federal Government and supported by a mill tax upon the property of a great commonwealth, with broad outlook and intense devotion to the welfare of the people, can be made the best institution yet devised by the wit of man for the promotion of human progress. University mottoes are sometimes inspiring, but the one that appeals to the writer most is from Cicero, De Legibus—'Salus Populi Suprema Lex.' The welfare (salus), construed broadly, is coextensive with public interests, which, beginning in the soil of earth and rising through human society, mount upwards finally to the Kingdom of Heaven.

R. H. JESSE.

SCIENTIFIC BOOKS.

Le système métrique des poids et mesures. Par G. BIGOURDAN. Paris, Gauthier-Villars. 1901.

A hundred years have passed since the inauguration of one of the most important reforms yet undertaken by civilized man, considered as to its far-reaching effects upon social, economic and scientific interests and conditions. Although the establishment of a universal and uniform system of weights and measures among all enlightened nations is not yet an accomplished fact, that most desirable end is so nearly reached that no reasonable person can for a moment entertain a doubt as to the final result. Only two great nations, constituting the English-speaking people of the world, still hold out against the irresistible movement in favor of uniformity of standards and they are both wavering very decidedly, preparatory to the inevitable yielding which the most thoughtful of their people are endeavoring to hasten. During the last decade in both England and America popular interest in the subject of

metrological reform has been unprecedentedly great and there is a general conviction that abandonment of the antiquated, inconvenient and unscientific systems of measure now in use must soon become an absolute necessity.

Under these conditions the excellent treatise of M. Bigourdan is a most timely and welcome contribution to available literature relating to the history of the origin and the gradual propagation of the metric system of weights and measures. In its preparation the author has had the advantage of convenient reference to original papers, state, scientific and personal, and in his résumé of the very important operations of the last quarter of a century, as embodied in the work of the International Bureau of Weights and Measures, he has been able to avail himself of the thorough knowledge of Messrs. Benoit and Guillaume, the two distinguished experts of that bureau.

The book begins with a brief discussion of the chaotic state of all matters relating to standards of measure during a few centuries preceding the coming of the metric system, in which little is said of anything outside of France. At a very early period in the history of metrology attempts were made to establish natural standards—that is, to refer ordinary standards of measure to something in nature fixed and unchangeable. It was not until 1670, however, that a really rational and scientific scheme was proposed by Gabriel Mouton, vicar of the Church of St. Paul in Lyons.

A few years earlier than this it had been proposed to refer the standard of length to the pendulum making a single vibration in one second or in some fraction of a second. Perhaps this suggestion came first from Sir Christopher Wrenn, and it was made about 1670–73 by Picard and by Huyghens. Mouton's system was *in principle* the metric system of to-day; he proposed to refer the standard of length to an arc of the terrestrial meridian; his multiples and submultiples of the unit were decimal, and he also proposed for convenience of reproduction a reference to the seconds pendulum. It is interesting to note that when Picard proposed the seconds pendulum as a standard of length in 1671, he expressed a suspicion that such a pendulum must be somewhat shorter near the equator than near the pole, although it was only in that same year that Richer went to South America to make a series of astronomical observations, during which this fact was actually proved.

During the next hundred years many suggestions looking to a reformation of standards were made in France and many projects drawn up to bring about a unification of weights and measures throughout the nation, but it was not until one was presented by Talleyrand, about 1789, that the real movement set in. In this project he advocates the use of the pendulum as a standard of length, and with evident appreciation of the importance of the matter with which he is dealing, he suggests a reference of the subject to a joint international commission, to be composed of an equal number of members of the French Academy of Sciences and of Fellows of the Royal Society of London. At about the same time an active agitation in favor of metrological reform began in England and also in the United States, its chief exponent in our own country being Thomas Jefferson. Unhappily neither of these movements came to much, for reasons that cannot here be gone into. The history of the creation of the metric system and its adoption by the French Government, which followed within a few years after Talleyrand's project was submitted, is pretty well known to those interested in this phase of the subject, and the details of it constitute the larger part of the volume under review.

The whole subject was in the beginning referred to a Commission which, with those that were subsequently appointed, fortunately included such men as Laplace, Lagrange, Borda, Mongé, Condorcet, Lavoisier, Delambre, Coulomb, Cassini and others, constituting a most brilliant array of Frenchmen most eminent in science.

Consideration was given to three 'natural' standards to which the unit of length might be referred: The length of a pendulum beating seconds, the quarter of the terrestrial equator and the quarter of the terrestrial meridian. The pendulum was rejected, principally because its use involved the elements time and force, both foreign to length; the equator was rejected because of the difficulty of measuring it, climatic

and other conditions rendering it relatively somewhat inaccessible; and the quarter of a terrestrial meridian was finally adopted. It is pleasing to note that throughout the discussion which led to this result, the influential members of the Commission, as well as many others not members, stood out against the use of any unit of length or mass already in use in France, as it was recognized that such use would be an obstacle to the introduction of the system among the people of other nations. An interesting episode of the initiative of the arc measurement was a controversy over the use of a sector in the determination of latitude or the newly invented repeating circle of Borda. Indeed it seems not unlikely that 'a desire to make the reputation of the circle of Borda' had some influence in the choice of the new standard as against the seconds pendulum. Delambre proposed to Borda to employ both sector and circle, but the latter dryly intimated that it was desired to ascertain if the sectors were good, and the matter was not pressed.

When the Commission was received by the King, Louis XVI., after its recommendations had been approved and before the formal beginning of its operations, his majesty, speaking to each one in turn of the special duties that had been assigned to him, asked Cassini (the fourth eminent astronomer bearing that name), to whom had been assigned the triangulation and measurement of latitudes, how it was that he was going to remeasure an arc of the meridian that his father and grandfather had already done before him. Did he hope to do better than they? To which Cassini replied that he would not so flatter himself, if he had not a great advantage over them in the fact that while the instruments which they used in measuring angles gave results correct to within fifteen seconds, that invented by Borda would enable him to reach a precision of one second.

M. Bigourdan's volume contains much detailed information relating to the work of the Commissions, with many interesting and important citations from original documents. The fundamental legislation by which the system was founded is fully discussed, the opposition to it is fairly presented, and the subsequent legislation and discussion leading to its final adoption by the nation as a whole receive satisfactory treatment. There is a chapter on the propagation of the system among foreign nations which leads up to the appointment of an international metric commission about 1870, and to the establishment of the International Bureau of Weights and Measures about 1875. The splendid work of the latter during the twenty-five years of its activity is treated in some detail and forms a fitting close to a most useful and interesting contribution to the history of metrology.

T. C. MENDENHALL.

A Treatise on Electromagnetic Phenomena and on the Compass and its Deviations Aboard Ship, Mathematical, Theoretical and Practical. By Commander T. A. LYONS, U. S. Navy. John Wiley & Sons.

The first volume of this treatise, the only one yet published, deals with electromagnetic phenomena, or radiation in all its protean forms. If the reader wants information about sun-spots or auroræ, about Crookes's fourth state of matter or Bjerknes's imitations of magnetic fields by pulsating discs, about the work of Hertz or the genesis and action of Röntgen rays, he will find it in this introductory volume. However many and however diverse the subjects discussed, they are all treated from the point of view of the wave-theory. Commander Lyons seems to hold a brief for the ether whose existence he seeks to remove from the condition of a working hypothesis and whose properties he tries very hard to define. This is indeed a difficult task; for he tells us, on page 9, that "the mathematician attributes to the ether properties necessary to the formation of equations expressing its energy; the physicist ascribes to it qualities essential to the explanation of facts; the electrician meets conditions that require further hypotheses; still others do not accept fully any one of these conceptions; and some even reject the ether altogether."

So conscious is the author of the paramount importance in physics and philosophical speculation of the medium which fills intermolecular as well as interstellar space, that he dwells with great insistence upon the experimental evidence which there is for its existence. He is so eager

to beget in the mind of the reader the strong etheric conviction of his own, that he does not hesitate to recall and repeat where such repetition seems to him necessary. It must be admitted that he has made out a very commendable case for the medium as well as for its magnetic, electric and luminous properties.

The book reads easily. The style is not severely didactic; it is clear, sometimes diffuse and occasionally rhetorical. Here and there we meet similes and metaphors that occasion surprise, partly by their unexpectedness and partly by their novelty or boldness. Thus we are told that when electromagnetic waves reach the more tenuous strata of our atmosphere, they illumine them, and as a consequence "we have those brilliant auroras that cap the magnetic poles like huge candle-extinguishers" (!) (p. 20). Again, "magnetic storms have overspread the continents of Europe and America at the same time, when every needle was affected as with a kind of frenzy—oscillating together, as if some gigantic Briareus reached out his hundred arms, and with a finger on every one moved them regularly or wildly as the mood was upon him" (p. 6). On page 41 we find 'a *mote* of ether' and on page 62 we are confronted with 'a *jungle* of electromagnetic manifestations.'

The following passage, which occurs on page 197, is quite Tyndallian:

> From ships of war cruising in every sea; from merchant vessels plying between the ports of the world; from observatories equipped with delicate instruments in various countries; from expeditions afloat and ashore specially fitted out for the purpose; and from numerous other private and public sources of many kinds—have been gathered, during long years, a multitude of observations of the magnetic elements; collated, classified and stripped of all discernible errors, they afford, when plotted on charts of the globe, an excellent insight into its magnetic condition.

We can hardly, however, bring ourselves to define the dyne as 'the unit of measure of magnetic intensity' (page 434), for we have hitherto accepted it as the unit of force. On the same page we read that "the weight of a body is the product of its mass by the force of gravity; the mass is everywhere a constant but hazy (!) factor, while gravity varies slightly from place to place, but is always accurately known. This being understood, the weight of a body will be spoken of as representing it." Adopting a word from this sentence, we cannot but qualify the above statement as somewhat 'hazy.' What we do know, and know clearly, is that the weight of a lump of matter depends conjointly on its mass and on the intensity of gravity, so that we can write

$$w = \lambda mg.$$

By a suitable choice of units, we can make $\lambda = 1$, and then we have

$$w = mg.$$

After stating that the mass of a body is constant, the writer might have said, in so many words, that its weight depends upon its position with respect to the center of the earth, and thence concluded that the important property of a body, both scientifically and commercially, is not its weight but its mass.

Ampère's theory of magnets is found on page 490 to be 'more rational than the theory of magnetized particles.' We should like to believe it, and consequently regret that the author did not give a few reasons in support of this opinion. The origin of the Ampèrian currents is no better known than that of the magnetization of the molecules in Weber's molecular theory, while the maintenance of the currents implies the further difficulty of a resistanceless circuit.

The author is very chary in the use which he makes of proper names. Doppler, it is true, gets credit on page 320 for his 'principle,' and Lissajous on page 52 for his 'figures.' Why not Lenz for his 'law' (page 410) and Zeeman for his 'effect' (page 503)? Peter the Pilgrim (Peregrinus) is mentioned *cum laude*, but Gilbert is passed *sub silentio!* Yet it was Gilbert, the philosopher of Colchester, who first explained the behavior of the compass and the dipping needle by his grand discovery that the earth itself is a huge magnet: *Magnus magnes ipse est globus terrestris* are his words. Surely Commander Lyons has read *De Magnete* either in the original Latin or in Mr. Mottelay's translation; so that his neglect of Gilbert's transcendent merits is hard to explain.

The magnetical discoveries of Columbus are

clearly stated on page 206, where is ascribed to him the first explicit record of a change in the variation (declination). "While Columbus," writes the author, "may not hence be said to have *discovered* the variation, he must be credited with having been the first to make it known, as well as the first to discover a line of no-variation." The author might have added that this agonic line lay a little to the west of the island of Fayal, one of the Azores; and he might also have informed the reader that the variation of the compass was not generally accepted as a fact until the middle of the sixteenth century—Gilbert's time—being supposed to be due to the mechanical defects of the compass itself.

The explanation of the earth-couple acting on the compass needle, given on page 383, is rather involved. The matter would be greatly simplified by discussing the usual expression, viz., $Hml \sin \theta$ deduced from a diagram on page 295. We notice that the author here resolves H at right angles to the length of the magnet, still the force acting at each end of the needle parallel to the magnetic meridian is not H but Hm; and the arm of the couple is $l \sin \theta$ so that the twisting moment is $Hml \sin \theta$.

It is necessary, when studying the distribution of free magnetism in a bar magnet, by the method given on page 181, to point out that the bar must be so placed that the axis of the compass-needle when at rest will lie in the magnetic meridian, with its north-seeking pole pointing magnetic north.

We are told on page 152 that a small magnetized bar will place itself equatorially when suspended between the poles of a horse-shoe magnet of nearly equal strength. This surely is a *lapsus calami*, for the bar will set, not equatorially, but axially.

A very important feature of this treatise is to be found in the diagrams and illustrations distributed throughout every one of its twelve chapters. Many of them are original, and are excellent efforts at representing graphically some difficult points in what we may term the physics of the ether. Teachers and students alike will find them very useful.

The author's object in the first part of his treatise is to give such information about the principal phenomena of magnetism and correlated subjects as will prepare the way for an intelligent grasp of the matter to be discussed in the second volume; and in this he has well succeeded. The work is full of up-to-date information set forth in a clear and frequently impressive manner. It makes one eager for the appearance of the concluding volume, which will treat of such practical matters as the compass, the ship considered as a magnet, swinging the ship, compensation of the deviations and the mathematical theory of these deviations.

Part I. extends to 556 pages and contains 368 figures, the whole put forth in the publisher's well-known excellent style.

M. F. O'REILLY.

Animal Life: a First Book of Zoology. By DAVID STARR JORDAN and VERNON L. KELLOGG. New York, D. Appleton & Co. 12mo. Pp. 329; frontispiece and 180 plates and figures in the text. Cloth, $1.20.

This handy, beautifully printed and illustrated book is a distinct attempt to introduce to the reader the subject of zoology from the standpoint of the life of the animal rather than from the purely systematic or comparative anatomy side. It is a book to read and enjoy in the fields and woods or at home rather than a manual to study in the laboratory. Its scope is well stated in the general headings of its sixteen chapters: (I.) The Life of the Simplest Animals; (II.) The Life of the Slightly Complex Animals; (III.) The Multiplication of Animals and Sex; (IV.) Function and Structure; (V.) The Life Cycle; (VI.) The Primary Conditions of Animal Life; (VII.) The Crowd of Animals and the Struggle for Existence; (VIII.) Adaptations; (IX.) Animal Communities and Social Life; (X.) Commensalism and Symbiosis; (XI.) Parasitism and Degeneration; (XII.) Protective Resemblances and Mimicry; (XIII.) The Special Senses; (XIV.) Instinct and Reason; (XV.) Homes and Domestic Habits; (XVI.) Geographical Distribution of Animals. Following the text proper are a table of the systematic position of the animals mentioned, a glossary and finally an excellent index.

In the subject matter of the volume one can-

not help feeling the advantage of a combined authorship, the senior author being primarily a student of vertebrate, and the junior author of invertebrate, life. This has insured a fairly balanced discussion of the phases of animal life in the two great divisions.

While, as stated above, this book is upon the life of the animal world rather than upon the anatomy, it is to be remarked that wherever the life processes are illuminated by the structure or development, these are freely introduced according to the guiding principle laid down by the authors: "Function and structure are always associated in nature and should always be associated in our study of nature."

It is gratifying to read such a book as this from cover to cover and find it free from vagaries. The authors, from personal knowledge and from the rich stores of the knowledge of others, have selected with great skill the facts illustrating each chapter, and have impressed these facts by excellent pictures, many of which are of their own production. In the discussion of the various topics, beyond the mere statement of facts, one constantly feels the certain hand of a master, a hand trained by personal knowledge and reflection and not dependent on the opinion of others. The book is very free from infelicities of expression and also from what seem to the reviewer doubtful statements. If two of the few observed might be mentioned, it is with the hope that future editions will modify the statements concerning the plate of embryos taken from Haeckel (p. 86), and also the statement on p. 107, that bones are not really living, etc. Taken in their setting these and a few other doubtful statements are true in spirit, but not quite in the letter. They can easily be made to conform with the vast majority of illustrations and be true both in spirit and in letter.

As a conclusion of this review a quotation from the chapter on geographical distribution will give an idea of the spirit and method of the authors:

"In California numerous anomalies [in distribution] have been noted, as the occurrence of Tahoe trout in Feather River, and in the Blue Lakes of Amador, which are on the other side of the main crest of the Sierra Nevada from Lake Tahoe, and the occurrence of the Whitney golden trout in Lone Pine Creek. In each case naturalists have found the man who actually carried the species across the divide. If this matter had been investigated a generation later, these cases would have been unexplainable anomalies in geographical distribution. Real causes are almost always simple when they are once known" (p. 288).

S. H. G.

GENERAL.

M. Octave Doin, Paris, has begun the publication of an elaborate 'Bibliothèque internationale de psychologie experimentale.' The subject-matter of psychology has been divided among fifty volumes, each of which is being prepared by a different author. France is, of course, fully represented, though the absence of certain names might be unexpected to those unacquainted with the personal conditions. Italy and Russia are well represented and there is one volume from England, 'Metaphysics,' by Mr. G. F. Stout, of Oxford; and two from America, 'Judgment and Knowledge,' by Professor J. Mark Baldwin, of Princeton University,' and 'Movement,' by Dr. R. S. Woodworth, of University and Bellevue Hospital Medical College. It is somewhat curious that the name of no German should appear on the list. The volumes, which will be on the average 300 to 400 pages in length, will be sold at the uniform price of 4 fr. Together they will form one of the most important encyclopedias that has been published in any science.

The Syndics of the Cambridge University Press have undertaken the publication of the first part of the 'Index Animalium' to the preparation of which Mr. C. Davies Sherborn has devoted so many years. The object of the Index is to provide zoologists with a complete list of all generic and specific names given by authors to animals both recent and fossil since January 1, 1758, the date of the 10th edition of Linnæus' 'Systema Naturæ.' With each name will be given an exact date and a reference intelligible to the layman as well as to the specialist. The British Association appointed a special committee to watch over the incep-

tion and progress of the work, the preparation of which was undertaken in 1890. Financial support has been given by the British Association, the Royal Society and the Zoological Society, while the authorities of the British Museum have afforded continual assistance. The work will be to the student of animal life what the 'Index Kewensis' is to the botanist, and indeed far more, as the last-named work refers only to Phanerogams, whereas the 'Index Animalium' will include all groups of animals and both recent and fossil forms. The portion of the work already completed and in the press covers the period from 1758–1800 and consists of 61,600 entries.

THE Society of German Engineers, in Berlin, has undertaken the preparation of an international technical dictionary to be published in English, French and German.

SCIENTIFIC JOURNALS AND ARTICLES.

The Journal of the Boston Society of Medical Sciences completes its fifth volume with the double number for May 23 and June 4, the index to the volume being issued with this number. From a small 16mo the *Journal* has grown to a volume of over 500 pages, although it shows at the same time the modern tendency towards specialization by containing more bacteriological and pathological papers than formerly. There is, however, much of general interest as well as important contributions to our knowledge of anatomy and physiology.

The Plant World for June contains 'Botanizing in Bermuda,' by Marshall A. Howe; 'Suggestions for the Study of the Hawthorns,' by W. W. Ashe, which notes that in place of ten species formerly recognized we know that at least 120 species occur on the Atlantic coast; 'Cuban Uses of the Royal Palm,' by William Palmer, and 'Botanizing in and around a Lake,' by E. L. Morris, besides briefer articles, notes and reviews. The supplement devoted to 'The Families of Flowering Plants,' by C. L. Pollard,' treats of the Mimosaceæ, Cæsalpiniaceæ, and the Papilionaceæ. The number is well illustrated.

SOCIETIES AND ACADEMIES.

ONONDAGA ACADEMY OF SCIENCE.

AT the June meeting Mr. Chas. G. Rogers presented a series of observations made during March, April and May, on the dates of arrival of birds on their spring migration, the blue-bird being first seen on March 15, and the robin appearing three days later.

Mr. Geo. D. Lynch read a paper on 'Hawks,' in which he described the food, and the nesting and defensive habits of Cooper's hawk, the sparrow hawk and the red-shouldered hawk, illustrating his remarks with specimens of skins and eggs of each of the three species.

Principal John D. Wilson read a paper embracing his observations on a family of bluebirds. He constructed a box in the shape of a prism about six inches square and fifteen inches deep, two opposite sides stopping about two inches short of the top, thus forming two entrances, protected from rain by a projecting roof. A narrow shelf was placed just beneath each entrance. Sparrows seemed unable to utilize the box for nesting purposes and so left it alone. They gathered about, however, when the young birds began to appear at the entrances, but were soon driven away by the parent birds. After the young were hatched they seemed to be fed solely by the mother, who invariably entered and left the nest by the opening on the south side. The male entered either opening indifferently, never brought food, and usually brought out excreta from the nest. Mr. Lynch spoke of similar observations on a robin's nest. The young birds were fed entirely on caterpillars, while the parent birds ate freely of cherries, monopolizing one tree, and even brushing their wings against the head of any person attempting to climb the tree.

Mr. Horace W. Britcher spoke briefly of the habits of some of the forms of life inhabiting a small springtime pond in which a form of the fairy shrimp (*Branchippus gellidus* Hay ?) occurs. The pond is usually dry from July to November. Larval *Branchippus* appear in February, and eggs are deposited during late April and early May, the water becoming so warm by the middle of May that the *Branchippus* are rapidly killed. A year ago eggs were collected and an attempt

made during the summer, and again during the winter, to hatch them in aquaria, but without success.

H. W. Britcher,
Secretary.

DISCUSSION AND CORRESPONDENCE.

THE LARYNX AS AN INSTRUMENT OF MUSIC.

It is with considerable hesitation that I venture to enter into a discussion that has arisen in this Journal under the above title. It is so likely to become a discussion of terms that may be defined by different writers in different ways that it is, perhaps, a question whether a prolonged discussion of the subject is desirable. In spite of this fact, however, I take the liberty of expressing an opinion to which I have been brought by the past several years of observations upon the larynx. Of course, we may call that part of the larynx which vibrates a 'cushion,' a 'reed,' a 'membranous reed,' a 'cord,' a 'membranous cord' or other names, and still find much justification in each case. It seems to me that if we wish to discuss the question as to the class of instruments to which this belongs, we must judge it by two series of facts: first, what elements control the pitch of the fundamental tone produced; second, what is the quality of the tone produced. If we examine the larynx with these points in view, we find, in the first place, that the pitch of the tone produced is controlled by three mechanisms: first, one for increasing tension; second, one for decreasing the length; third, one for lightening the weight of the vibrating part. These three factors are those used for controlling the pitch of a string. If we examine the quality of the tone produced we find that the fundamental and over-tones form a series whose rates of vibration are to each other in the order of the natural numbers, 1, 2, 3, 4; etc., this quality of tone is the quality produced by a string and not the quality produced by a reed or membrane, in both of which the quality is much more complex and contains many intermediate over-tones. It seems to me, in view of these considerations, that we refer to this vibrating part as a 'cord' quite properly. It will be admitted, undoubtedly, by all that the tilting of the cricoid cartilage on the thyroid cartilage increases the tension on the vocal cords, and in so doing raises and tends to control their pitch. The arytenoid cartilages when brought together bring out the edges of the vocal cord from the side of the tube, and by their rotation may decrease the free length of the vocal cords, as is clearly shown by photographs that have been taken of the larynx when producing tones of different pitches. In Fig. 1 we have a section

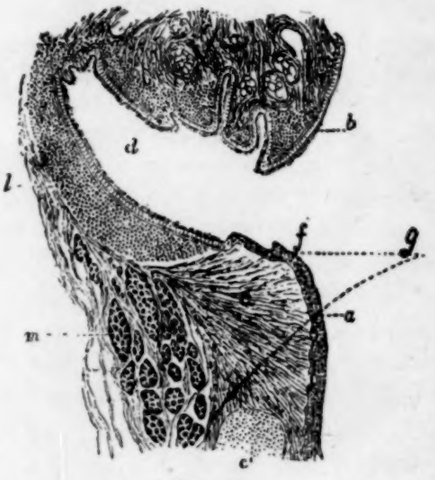

Fig. 1.

through the vocal cord and its immediate surroundings. It is shown in the relaxed position against the wall of the tube. The dotted line between $a \ldots g \ldots f$ shows, approximately, the position and form of the cord in action. In Fig. 2 is shown, diagrammatically, a cross-sec-

Fig. 2.

tion of the vocal cord, the point extension at k being rather exaggerated. m is the vocal muscle extending from the inside front of the thyroid to the outer side of the arytenoid, and passing through the back of the vocal cord. This muscle serves to rotate the arytenoid, and

thus shorten the vibrating portion of the cord; at the same time certain fibers from this muscle extend outward into the cord toward *s*, *t*, *u*, etc. The action of these fibers, when the vocal muscle is contracted, tends to hold rigid more and more of the cord, allowing less and less of the extreme edge to vibrate. This action lessens the weight of the vibrating part of the cord.

Other minor facts tend to confirm the belief that the action is essentially that of a cord. For example, the extreme edge, as indicated at *k*, is of a different material from the rest of the cord and the whole structure of the cord is entirely different from that of the lips, or from what could be properly defined as a cushion. In observations upon the vocal cords when producing a tone it is very often easy to recognize certain secondary nodal points in the cord. If a little mucus happens to be upon the vocal cord at the time of producing a continued tone, the mucus collects at the secondary nodal points, just as sand upon a vibrating plate, and is easily apparent as a white spot upon the edge of the cord.

Of course, in those cases where the larynx has been removed and an artificial voice apparatus has been introduced, the source of sound has been a reed, but this has been simply from a mechanical difficulty of introducing a vibrating string which should have the proper range. The reed is extremely simple mechanically and answers the purpose quite satisfactorily. But this offers no argument in support of the belief that we are dealing with a reed instrument in the human voice. It is true that Helmholtz and others have referred to the larynx as a reed instrument, but it is curious to note that after this reference has been made, Helmholtz continues in the most elaborate way to treat the quality of the sound produced by the human voice as if it had been produced by a vibrating string, discussing the pitches and intensities of the over-tones of a string and never referring to other over-tones of a reed or a membrane.

It is claimed that the vibrations of the air in the mouth cavity are 'free vibrations' and not 'forced' ones and that these free vibrations in the mouth cavity are excited by the impulses from the larynx formed by the explosive openings between the vocal cords. In this connection Professor Scripture, in his contribution from the Yale Psychological Laboratory, describes an experiment of making a key whistle by blowing in its end a stream of air, which has been rendered intermittent by artificial vocal cords. No one denies for a moment that impulses or a succession of impulses may set up the natural vibrations of a resonance cavity, but it must also be borne in mind that a continuous stream of air under the same circumstances will produce a more forcible result just in proportion as the energy in the continuous stream is greater than in the interrupted stream. Thus, we know that a continuous current will cause a key to whistle, and there is no mechanical reason why an interrupted current should not produce a similar result while the puffs last. Applying this to the mouth cavity as related to speech, we have a natural vibration set up in the case of a whisper by the continuous current of air rushing through these cavities. Interruptions in this current will not increase the intensity of the natural vibrations of the air in the cavities. We have precisely an analogous case if we simply blow through a clarionet or cornet or flute without establishing the primal source of sound by the vibration of the reed, the lip, or the air jet.

It seems to me that, fundamentally, there can be no difference between a vowel as sung and that same vowel as spoken. Of course, the duration of the vowel sound may be very short, but during that period it must have its perfectly definite quality in order to be recognized, and it seems incorrect to assume one set of determining factors in case of a spoken vowel and another set in the case of the vowel as sung. The problems involved in this discussion, overlapping the subjects of anatomy, physiology and mechanics, are naturally very troublesome, and it is readily to be expected that the physicist is perhaps inclined to lay too much stress upon the mechanics of air vibrations. But on the other hand, the physiologist and the students of phonetics have in too many cases brushed aside serious mechanical obstacles with a nonchalance that is scarcely justified by the facts. In those cases where the synthesis of the vowel

sounds has been most satisfactory they have been made up of the fundamental and *string* over-tones and not by the combination of the pitch tone with a 'characteristic pitch' having no harmonic relations between the two. In the case of spoken vowels it seems to me of fundamental importance that the individual should speak upon a known pitch, otherwise the case is hopelessly confused by a constantly changing fundamental. In a great many of the investigations involving the so-called characteristic pitch of the different vocal sounds, it seems uncertain as to whether or not this so-called 'characteristic pitch' may not be more directly due to some inherent rate in the apparatus itself, rather than in the sound which it is supposed to record impartially. In this connection it must be borne in mind that the widest possible variations in tone quality are still recognized as the same vowel spoken by different individuals under different conditions. This discussion has wandered from the musical instrument to the articulator. In music the vowel is everything, the consonant usually inconspicuous; in speech the vowel is secondary and the consonants all important.

William Hallock.

Physical Laboratory,
Columbia University, June, 1901.

'Is larvæ contagious?'

The following cross interrogatories were prepared by the district attorney of a county in a western State for a deposition.

What is larvæ? What does larvæ come from? Is larvæ injurious to fruit trees? Is it contagious?

What is pupæ? Describe it fully? Is it injurious to fruit trees? Is it contagious?

It seems to me that the questions furnish an answer to the frequent question in the scientific laboratory, 'Will this ever be of any use to me?' If such knowledge furnish nothing else to a man, it would prevent him from making such questions as these. H. S. Gaus.

Current Notes on Physiography.

Glacial Corries in the Bighorn Mountains.

The glaciated district near Cloud Peak, Bighorn Mountains, at altitudes above 10,000 feet, contains over forty corries or cirques of more or less pronounced form, as mapped and described by Matthes ('Glacial Sculpture of the Bighorn Mountains, Wyoming,' 21st Ann. Rep. U. S. Geol. Surv., 1900, pt. II., 167–190). A contour map shows the summit of the range in general with rounded forms free from sharp peaks and precipitous cliffs. The valleys on the slopes below 10,000 are usually broadly open; but on ascending towards the stream sources, the valley walls steepen on either side of a broad floor where rock basins hold many little lakes, and at or near the valley head the walls close in a great cliffed amphitheater. Highland streams cascade down from shallow hanging valleys into the deep cirques. It is concluded that these peculiar forms are here, as elsewhere, to be regarded as glacial modifications of preexistent valleys that once had more ordinary form. In a few cases, the widening and headward recession of the valley walls have resulted in the consumption of the rounded uplands of the mountains so far that only a narrow, sharp, serrate wall remains; this is well seen around Cloud Peak, thus giving support to Richter's views regarding the importance of glacial action in producing sharp peaks and arrêtes in the Alps. In a single remarkable example, an east-sloping valley (No. 20) receives the drainage of the uppermost mile of a southwest-sloping valley (No. 18) in such a way as to suggest very strongly the glacial capture of the latter by the former; and this is made the more probable when it is noted that the capturing valley has a distinctly stronger slope than the captured. If it be admitted that glacial erosion has made significant changes in the valley forms—and this does not seem to be open to dispute—the present pattern of drainage in these two valleys could not have existed in preglacial time.

It is a curious commentary on the education of our topographers that articles of the kind here referred to should be so rare.

The North German Lowland.

The accounts of the North German lowland as a region of glacial topography by Berendt, Wahnscahaffe, Keilhack and others are supplemented to an extraordinary degree of detail by

the folio sheets of the geological map (1:25,000) of Prussia and the Thuringian states, with explanatory texts. Several sheets of the area north of Berlin may be cited. In the neighborhood of Oderberg (46th Lieferung), the Oder turns sharply from the ancient westward waterway along the glacial margin past the site of Hamburg to the North Sea, into its present northward course past the site of Stettin to the Baltic. Hereabouts are several looped moraines with uneven hills and hollows, holding many pools and ponds; the loops are nicely marked by boulder belts, which have long furnished material for road-making. Outside of the morainic loops (southwest), stretch outwashed sand plains, the barren 'upper sands,' with deep-lying ground water. Inside of the moraines come the rolling uplands of the ground moraine, with a fertile soil. Overlaid sands and silts are common here, the deposits of ice-margin lakes held in the loops during glacial retreat; the outlets of the lakes are frequently found in trenches through the morainic hills. Some of the larger existing lakes of the district remain in shallow basins, roughly central to the morainic loops.

South of the outwashed sand plains, the broad channel of the ancient waterway (the Thorn-Eberwalder channel, the northern of the three chief ice-margin waterways) is strewn with the 'valley sands.' Once as smooth as the bed of a large river may be, these sands are now trenched and terraced to moderate depths west of Oderberg, where they are traversed only by small streams; but they are largely swept away southeast of Oderberg, where the ice-margin river sank to a lower level when the northern outlet past Stettin was opened. A new, broad channel was eroded at the lower level, with great sweeping curves appropriate to the course of a large river; the channel bed now remains as a marshy alluvial plain on which the diminished Oder wanders. One of the great curves of the channel rounds a spur of drift uplands by Oderberg; the 'new Oder' is led through the narrow neck of the spur by an artificial canal, while the 'old Oder' still straggles around the spur.

Where the ancient waterway departed somewhat from the moraines, a low upland slopes southward to it from the morainic loops and their sand plains. The upland here is a gently rolling drift plain, traversed now and again by the sandy beds of larger or smaller streams that for a time came out from the ice on the north. A striking example of this kind is found near Kyritz (Lieferung, northwest of Berlin). The sandy stream bed was probably washed by sprawling currents in many braided channels, which acted partly as an aggrading agent, for the bed is hardly incised beneath the rolling drift plain. Later a narrow trench was cut through it, as if the ice-water had for a brief interval been changed from a turbid sand-bearing stream to a clear stream (perhaps the outflow of an ice-margin lake); the trench is now floored with peat, or occupied by long shallow lakes, as if it were barred here and there with inwashed alluvium.

The casual traveller often describes the north German lowlands as a 'flat and uninteresting country.' It is as meaningless to him as a cuneiform inscription would be; yet how significant its delicate details become when interpreted! To American students, the elaborate treatment of this remarkable field foreshadows what may in time be provided for us concerning the Illinois and other glacial lobes, whose general features only have now been sketched.

W. M. DAVIS.

MUSEUM REPORTS.

THE 'Annual Report of the Director' of the Carnegie Museum for the year ending March 31, 1901, was issued a short time ago, as well as the report on the 'Prize Essay Contest.' From the report we learn of the rapid progress of the institution particularly in the field of vertebrate paleontology, the explorations conducted last year by Mr. J. B. Hatcher having resulted in the acquisition of nearly 200 boxes of specimens, some of the more notable of which were described a short time ago in SCIENCE. As Mr. Hatcher again began field work in April, the present year will doubtless see other important accessions of fossils.

In zoology the announcement is made that the Museum has acquired a specimen of the almost extinct *Rhinoceros simus*, only four other ex-

amples of which are in existence. It is also announced that the Museum last year purchased the Ulke collection of Coleoptera. Among other illustrations the report contains a fine view of a remarkable lot of 'cannon-ball' concretions in Laramie sandstone.

It is announced that no less than 843 scholars participated in the Prize Essay Contest, the subject being 'An Afternoon at the Carnegie Museum.' The successful essay is printed in full and the names and addresses of the other contestants are given.

The Annual Report of the President of the American Museum of Natural History for the year 1900 is also at hand. The most evident progress has been made in arranging the extensive anthropological collections of the Museum, and the new West Hall, devoted to the American Indian and Eskimo, was opened on November 1, 1900.

No less than seven expeditions were sent out during the year to conduct ethnological and archeological researches, including one to Siberia and another to the vicinity of Lake Titicaca. This extended work was made possible through the liberality of friends of the Museum.

The Department of Vertebrate Paleontology, which completed its first decade in May of this year, comprises in its collections 8,534 specimens of fossil mammals and about 4,000 of reptiles. The most important accessions during 1900 were a complete skeleton of the herbivorous dinosaur, *Thespesius*, and one of a carnivorous dinosaur, several partial skeletons of horses from Texas, and a skull of elephant.

The attendance during the year was 523,522, an increase of a little more than 65,000 over the previous year. It is announced that the income from the endowment fund is now $20,280, and while this is gratifying it is to be wished that it were ten times as great. For the first time in many years the report contains no illustrations, but this is more than compensated for by the publication of the *Museum Journal*, which chronicles the current progress of the institution.

F. A. L.

*THE AMERICAN CHEMICAL SOCIETY.**

The Twenty-Fourth General Meeting of the American Chemical Society will be held in the High-School building, on the block bounded by Nineteenth, Stout, Twentieth and California Streets, Denver, Colorado, Monday and Tuesday, August 26 and 27, 1901.

The same arrangements as heretofore will prevail between Section C of the American Association for the Advancement of Science and the American Chemical Society. Monday and Tuesday of the Association week will be devoted mainly to the sessions of the American Chemical Society, and the remainder of the week to those of Section C. A few minutes will be given to Section C for organization on Monday morning, and in the afternoon the American Chemical Society will adjourn in time to afford the opportunity of listening to the address of the Vice-President of Section C.

The first session of the Society will convene on Monday morning, August 26, immediately after the organization of Section C of the A. A. A. S., probably at about 11.30 A. M.

The afternoon session will be called to order at 1.30 P. M , and will be adjourned in time to listen to the address of Vice-President Long before Section C.

At the close of Vice-President Long's address, a meeting of the Council and Directors of the American Chemical Society will be held at some convenient place to be announced.

The hour for the morning and afternoon sessions of the Society on Tuesday will be announced on the program. Other arrangements for the meeting will also appear in the official program, or be announced at the sessions of the Society.

Hotel headquarters for the meeting will be at the Brown Palace Hotel, Seventeenth and Tremont Streets. Rates: American plan, $3.00 to $5.00 per day; European plan, $1.50 up. This hotel is within five minutes' walk of the Denver High School Building, and is reached from the Union Depot by the Seventeenth Street electric car line.

The following is a list of other hotels and boarding houses easily accessible to the Denver High School:

* Announcement of the secretary.

The Albany, 17th and Stout Streets. American plan, $2.00 to $4.00; European plan, $1.00 to $2.00 per day.

The New St. James, Curtis Street, between 15th and 16th Streets. American plan, $2.00 to $3.50; European plan, $1.00 to $2.50 per day.

The Oxford, 17th and Wazee Streets, one block from Union Depot. European plan only, $1.00 to $2.00 per day.

The Windsor, 18th and Larimer Streets. American plan, $2.00 to $3.50; European plan, $1.00 to $2.00 per day.

American House, 16th and Blake Streets. American plan, $2.00 per day.

Hotel Metropole, opposite Brown Palace Hotel. American plan, $2 50 to $5.00 and up; European plan, $1.00 to to $3.00 per day and up.

Hotel Albert, 17th and Welton Streets. European plan, $1.00 to $1.50 per day.

The Belvoir, 737 East 16th Avenue. Room and board, $1.50 to $2.00 per day.

The Bonaventure, 18th and Glenarm Streets. European plan only, 75 cents to $1.50 per day.

The Broadway Hotel, Broadway and Cheyenne Street. American plan, $1.50 to $2.00 per day.

The Drexel, 433 17th Street. European plan, 75 cents to $2.00 per day; $4.00 to $8.00 per week.

Douglas Place, 1439 California Street. Room and board, $1.50 per day; $7.00 per week and up.

The Grant, 1922 Grant Avenue. Room and board, $1.25 per day; $8.00 per week.

The Holland, 17th Street and Pennsylvania Avenue. Room and board, $1.50 to $2.00 per day.

The Princeton, 2137 Stout Street. Room and board, $5.00 to $7.00 per week.

The Vallejo, 1420 Logan Avenue. Room and board, $2.00 to $4.00 per day.

The Vaille, 208 17th Street. European plan, $1.00 to $2.00 per day.

Warren Hotel, 17th and Larimer Streets. Rooms, 75 cents to $2.00 per day.

Young Women's Christian Association, 18th Street and Sherman Avenue. Ladies only.

Reservations for accommodations should be made as early as possible, by direct correspondence with the hotels and boarding houses. The Local Committee on Hotels and Boarding Houses will also be glad to give information on this subject. Address communications to Arthur Williams, Local Secretary, P. O. Box 1504.

The Western Passenger Association, covering the territory west of Chicago and St. Louis, has made a rate of one fare plus $2.00 for the round trip, in their territory, to Denver, Colorado Springs and Pueblo. The tickets may be bought from July 10 to August 31, and are good for return up to October 31. At this rate the fare from Chicago to Denver and return will be $31.50. The Pullman fare is $6.00 extra each way. Rates from points east of Chicago will be announced later in the columns of SCIENCE.

It is probable that there will be, however, a choice of the following terms:

1. A rate of one and one-third fare on the certificate plan for the round trip from starting-point to Denver and return.

2. Full fare from starting-point to Chicago and return, and the above rate of $31.50 from Chicago to Denver and return.

3. Regular season rates for Colorado tours.

Which of these terms will be the most advantageous must be ascertained by inquiry at the various local ticket offices.

The Pullman rates from New York to Chicago will be $5.00 extra each way, and those from other points can be ascertained upon inquiry at the various local offices.

If rates are obtained on the certificate plan, the name 'American Association for the Advancement of Science' should appear on the certificate, as all arrangements of this kind are made by that body and not by the American Chemical Society.

Various visits and excursions will be arranged by the Local Committee of the A. A. A. S. and the Local Committee of the American Chemical Society. These will probably include visits to the smelting and reduction works in the vicinity of Denver, and other places of special interest to chemists.

Members who have papers to present at the meeting are requested to mail to the Secretary, in the enclosed envelope, as soon as possible, name of author, title of paper, and estimated

time for reading the same. It is also earnestly requested that *all members of the Society fill out and return the enclosed slip at once*, whether they expect to attend the meeting or not, being careful to give the name and address as they should stand on the official roll of the Society, which is now being revised for the annual directory.

Manuscripts and abstracts of papers may be sent to the Secretary, Albert C. Hale, addressed to Jewett, Greene Co., N. Y., till August 15; after that date they should be addressed to him at the Brown Palace Hotel, Denver, Colorado.

Many of the members responded with praiseworthy interest and zeal in the effort to increase the membership of the Society to 2,000 before the date of the 25th anniversary meeting last April. The time, however, was not sufficient in which to attain the desired result, but it has been suggested that a sufficient effort now on the part of every member of the Society would enable us to raise the roll of membership to 2,000 before the presentation of the Secretary's annual report in December. *Will you not give your personal attention to this matter*, and see that the enclosed blank is properly filled out with the name and qualifications of some eligible chemist, not now upon our roll, whom you will nominate for membership, returning the blank to the Secretary at your earliest convenience? Additional blanks may be obtained from the Secretary at any time, or will be forwarded by him to any chemists whose names are furnished him for that purpose.

ALBERT C. HALE,
Secretary of the American Chemical Society.
July, 1901.

RAILWAY TIME TABLES BETWEEN THE EAST AND DENVER.

AT the request of the permanent secretary of the American Association, Dr. L. O. Howard, we publish time tables of some of the railways between the East and Denver. We hope to give subsequently further details.

PENNSYLVANIA RAILROAD COMPANY.

Leave New York.	Leave Philadelphia.	Leave Baltimore.	Leave Washington.	Arrive Chicago.
7:55 a. m.	10:25 a. m.			7:45 a. m.
	8:40 "	8:50 a. m.	7:50 a. m.	7:45 "
1:55 p. m.	4:30 p. m.	4:35 p. m.	3:30 p. m.	2:50 p. m.
5:55 "	8:50 "	9:00 "	7:45 "	8:45 "

Leave Chicago.		Arrive Denver.	
10:00 a. m.		11:30 p. m.	C. & N. W.
11:30 p. m.		7:30 a. m.	"
4:00 "	(same station.)	6:30 p. m.	Burlington.
11:00 p. m.		7:10 a. m.	"

Via St. Louis.

Leave New York.	Leave Philadelphia.	Leave Baltimore.	Leave Washington.	Arrive St. Louis.
9:55 a. m.	12:20 p. m.	12 noon.	10:50 a. m.	12:56 p. m.
1:55 p. m.	4:30 p. m.	4:35 p. m.	3:30 p. m.	6:40 "
5:55 "	8:25 "	8:30 "	7:15 "	9:40 "

Leave St. Louis.	Arrive Denver.	
2:05 p. m.	6:15 p. m.	Burlington.
9:01 "	7:10 a. m.	"
10:10 "	12:05 p. m.	Mo. Pacific.
10:10 "	7:30 a. m.	C. & A.

BALTIMORE AND OHIO RAILROAD COMPANY.

This route is either *via* Chicago or St. Louis, thence over any of the several connecting lines between those points and Denver.

For instance:

Leave	New York	1:30 p. m.	Monday.
"	Philadelphia	4:20 "	"
"	Baltimore	7:00 "	"
"	Washington	8:05 "	"
Arrive	Chicago	9:00 "	Tuesday.
Leave	Chicago	10:00 "	"

Via C. R. I. & Pacific Ry.

Arrive	Denver	7:45 a. m.	Thursday.
	or		
Leave	New York	4:30 a. m.	Monday.
"	Philadelphia	7:00 "	"
"	Baltimore	9:40 "	"
"	Washington	10:50 "	"
Arrive	Chicago	9:00 "	Tuesday.
Leave	Chicago	10:00 "	"

Via C. & N. W. Ry. and U. P. System.

Arrive	Denver	1:45 p. m.	Wednesday.

Similar connections can be made *via* St. Louis.

Passengers reaching Chicago from the East before 1 p. m., can use the 'Rocky Mountain Limited,' which leaves Chicago daily at that hour, reaching Denver the following afternoon at 4:45.

THE SOUTHERN RAILWAY.

Leave	New York	12:10 a. m.	4:25 p. m.
"	Philadelphia	7:20 "	6:55 "
"	Baltimore	9:34 "	9:16 "
"	Washington	11:15 "	10:45 "
"	Atlanta	6:00 "	4:15 "
"	Birmingham	12:45 p. m.	10:20 "
"	Memphis	8:25 "	10:25 a. m.
Arrive	Kansas City	9:45 a. m.	7:10 "
Leave	Kansas City	6:40 p. m.	10:40 "
Arrive	Denver	11:10 a. m.	6:00 "

SCIENTIFIC NOTES AND NEWS.

AT the meeting of the Senate of London University on July 11, Professor A. W. Rücker, professor of physics in the Royal College of Science and secretary of the Royal Society, was elected principal of the University.

AT the first congregation of the University of Birmingham, on July 6, the degree of Master of Science was presented to the following officers of the University: Dr. Oliver Lodge, principal; Robert S. Heath, vice-principal and professor of mathematics; Bertram C. A. Windle, dean of the faculty of medicine and professor of anatomy; John H. Poynting, dean of the faculty of science and professor of physics; Thomas Bridge (zoology), Charles Lapworth (geology), William Hillhouse (botany), Percy F. Frankland (chemistry), Frederick W. Burstall (engineering), Adrian J. Brown (brewing), Bostock Hill (public health), Gilbert Barling (surgery), Bennett May (surgery), Alfred H. Carter (medicine), Robert Saundby (medicine), Edward Malins (midwifery), Priestly Smith (ophthalmology), Arthur Foxwell (therapeutics), Robert F. C. Leith (pathology), James T. J. Morrison (forensic medicine), Edmond W. W. Carlier (physiology), John W. Taylor (gynæcology).

SECRETARY of Agriculture Wilson, Mr. E. Henry Stevens, of the House Committee on Agriculture, and Professor Milton T. Whitney, chief of the division of soils of the Department of Agriculture, made last week a trip through Connecticut and western Massachusetts, seeking facts and information relative to the growing of tobacco under cloth in those sections.

UNDER the auspices of the New York Botanical Garden, Professor Lucien M. Underwood, of Columbia University, has visited Porto Rico, and Dr. M. A. Howe, assistant curator of the museum, has explored the coasts of Nova Scotia, Newfoundland and New Brunswick.

SURGEON KINYOUN, recently of San Francisco, and now in charge of the Marine Hospital at Detroit, has been detailed to visit Japan and China to inspect the work of the marine hospital service with special reference to the plague.

DR. FESHENKO, of the University of St. Petersburg, has been sent by the Imperial Geographical Society to the Pamir, and is at present at Tashkent making geological, botanical and zoological researches.

DR. E. J. LEDERLE, chief chemist of the Health Department of New York City, sailed on July 18 for Europe, where he will inspect the municipal laboratories of Europe, including Paris, Brussels, Cologne, Berlin, London, Glasgow, Edinburgh and Dublin.

MESSRS. DARTON, Hatcher and Fraas have completed the special study of the Titanotherium Beds in South Dakota for the U. S. Geological Survey. The work was greatly impeded by exceptionally rainy weather. Mr. Darton will report upon the results which will subsequently be used in the monograph on 'The Titanotheres' by Professor Osborn.

PROFESSOR LESTER F. WARD, of the U. S. Geological Survey, has recently made a two months' trip in the Triassic of Arizona, studying the geology and collecting fossil plants. A small but valuable collection of fossil vertebrates was made at the same time for the U. S. National Museum.

PROFESSOR STEWART CULIN, curator of the Pennsylvania University Museum, has returned to Philadelphia, after a visit to Cuba in search of traces and relics of the aboriginal Indian tribes.

THE American astronomers who went to Sumatra to observe the eclipse of the sun in May arrived at San Francisco on the *Indiana* on July 16. The members of the party include Professor E. E. Barnard, Professor A. N. Skinner, Commander U. S. N.; Professor W. S. Eichelberger, U. S. N.; F. B. Littell and H. D. Curtis.

REUTER'S AGENCY telegraphs from St. Petersburg that Baron Toll, the leader of the Russian Arctic expedition, has sent to the Academy of Sciences the following despatch from Yeniseisk, dated April 16: "Safely arrived in the Gulf of Taimyr, where I am wintering. We have erected a station for meteorological observations in the neighborhood of Archer Harbor. Mathiessen has explored the Nordenskiöld Islands, traveling in sledges. Kolomeizeff has been sent to the mouth of the Yenisei with

orders to establish a coaling station. I myself shall traverse the Cheliuskin Peninsula with Koltschak. Matthiessen has been appointed commander of the *Sarja*. All are well."

PROFESSOR ERNST HAECKEL has consented to give a course of lectures on paleontology in London.

DR. TRACY F. HAZEN, recently fellow in botany at Columbia University, has been appointed director of the Fairbanks Museum of Natural Science at St. Johnsbury, Vt.

MR. E. G. HASTINGS, who has held the position of assistant bacteriologist at the University of Wisconsin Experiment Station, has been granted leave of absence for a year's study in Europe. His position will be filled in the interim by Mr. John F. Nicholson.

A STATUE of Chevreul was unveiled on July 11 in the Paris Museum of Natural History.

DR. JAMES MARVIN died at his home at Lawrence, Kansas, July 10 last, aged 81 years. Dr. Marvin was educated at Alfred Academy (now Alfred University) and Allegheny College, in both of which institutions he was subsequently a teacher. For a number of years he was superintendent of schools at Warren, Ohio, from which place he went to Allegheny College as professor of mathematics and astronomy. In 1874 he was called to the chancellorship of the University of Kansas, doing much during his ten years' service to build up that institution. Later he became the first principal of Haskell Institute, one of the leading government schools for Indians, and laid the foundations for what has since become a great school. His public service closed with a six years' term as pastor of a Methodist church at Lawrence. For several years he had been an invalid, slowly declining under the action of paralysis.

THE death of H. W. Harkness, which we announced last week, will be a serious loss to science in San Francisco. Born eighty years ago in Massachusetts, he went to California in 1849, and, having amassed a considerable fortune by the practise of medicine, retired in 1869 and devoted himself chiefly to scientific interests. He was from 1887–1896 president of the California Academy of Sciences. He was the author of numerous contributions to botany, chiefly on the cryptogams. He presented his collections, containing 10,000 specimens, to the Academy of Sciences.

MISS EVA M. REED, indexer in the library of the Missouri Botanical Garden at St. Louis, was instantly killed by a train while walking on the tracks near Louisiana, Missouri, on July 7. The body was interred at St. Louis. Miss Reed had been connected with the Botanical Garden for about seven years, going to that institution from the University of Wisconsin. She was deeply interested in botanical pursuits, giving attention to the mosses, as well as to the winter characters of trees, a subject on which she had written for publication. Not long ago she began working on plant ecology, under the direction of the botanical department of the University of Chicago, and it was in the prosecution of investigation in the field that she met her death.

SIR CUTHBERT EDGAR PEEK, who maintained at Rowsdon an astronomical and meteorological observatory, died on July 5, at the age of forty-six years. He went to Queensland on the last transit-of-Venus expedition, and made numerous contributions to astronomy and meteorology. He was an active supporter of scientific work, being a member of the council of the Royal Geographical Society and of the Royal Meteorological Society and honorary secretary of the Anthropological Society.

THE death is announced of Miss Eleanor A. Ormerod, known for her contributions to economic entomology, on which subject she had published a number of works. She was recently given the LL.D. degree by the University of Edinburgh, where she had been examiner in agricultural entomology.

THE death is also announced of Dr. Gino Ciaccio, professor of comparative anatomy at the University of Bologna, and of James Hamblin Smith, of Gonville and Caius College, Cambridge, a famous coach of the University and the author of several works on elementary mathematics.

THE New York City Municipal Civil Service Commission will hold on July 31 an examination for the position of assistant bacteriologist with a salary of $1,200.

IT is stated in *Nature* that the London Institution of Mining and Metallurgy will award twenty-five guineas each for the best papers on the comparative merits of circular and rectangular shafts for mines of great depth.

THE Association of Military Surgeons proposes as a subject of its Enno Sander prize for 1901–1902 'The Most Practicable Organization for the Medical Department of the United States Army in Active Service.' The prize is a gold medal and $100. The essays must be submitted before the end of February, 1902. Further particulars may be obtained from the secretary, James Evelyn Pilcher, Carlisle, Pa.

THE physiological laboratory given to the University of Edinburgh by Mrs. Cox in memory of her father, the late Professor John Hughes Bennett, was dedicated on July 20, an address being made by Sir J. Burdon Sanderson.

THE Board of Supervisors of San Francisco adopted a resolution on July 15 accepting the offer of Mr. Carnegie to give to this city $750,000 for the establishment of a central and branch libraries. The concluding sections of the resolutions read as follows:

Be it resolved, That the gift of Andrew Carnegie be and the same is hereby accepted, and that the thanks of the Board of Supervisors of the city and county of San Francisco be and are hereby extended to him. And be it further

Resolved, That the example set by Mr. Carnegie in distributing his vast private fortune to great public purposes, and at the same time inducing municipal cooperation in channels which might otherwise be neglected, should serve as an example to other citizens and meet the approval and encouragement of all.

BARON IWASAKI has purchased the library of the late Professor Max Müller, containing 13,000 volumes, for presentation to the University of Tokyo.

AIDED by a special fund presented by a friend of the American Museum, Professor Osborn has sent out two expeditions especially in search of fossil horses—one to Texas and one to eastern Colorado. Word has just been received at the museum that the very first discovery made by the Texas party included a deposit of skulls of the three-toed horse, *Protohippus*, associated with parts of the limbs, feet and backbone. This is one of the stages especially desired in the long series leading up to the modern horse. The skulls are reported to be the best that have thus far been found, and this discovery is an auspicious opening to this special series of explorations. *Protohippus* belongs to the Pliocene, and is believed to be the immediate ancestor of the true horse.

THE New York Zoological Park has just received from the Galapagos Islands via San Francisco, five very large giant tortoises, representing three species, *Testudo microphyes*, *vicina* and *elephantopus*. The largest is a very old specimen measuring, in straight lines, 42 inches in length, 30½ in width, and in height 20 inches. Its weight is 310 pounds. Three other specimens weigh respectively 156, 129 and 118 pounds. These five specimens represent the pick of a lot of 13 collected in the Galapagos group last winter by Capt. William Johnson, of San Francisco.

THE *Bulletin* of the New York Botanical Garden states that the first instalment of the Vigener Herbarium, the purchase of which was arranged by Dr. Britton while in Europe last fall, has lately been received. This portion of Mr. Vigener's herbarium contains the Schaffner Mexican collection numbering about 4,500 specimens, many of them duplicated, and thus valuable for future exchanges, and that part of a general collection consisting of cryptogams, and the flowering plants from the *Ranunculaceæ* to the *Leguminosæ*, according to the DeCandollean system, numbering 10,877 specimens. This important accession was made by means of funds provided by Mr. Andrew Carnegie.

THE Paris correspondent of the London *Times* writes under date July 2: I went yesterday to Vesinet, a pretty little village between Paris and St. Germain, where I witnessed some most interesting experiments in wireless telegraphy by Colonel Eugene de Pilsoudski, an engineer of the Russian army. His system depends in no way upon the air for transmission of the current. The earth itself is his conductor. He established his apparatus in two villas about one kilometer apart. The messages were transmitted clearly, rapidly,

and without the slightest hitch. The current passes from the transmitter to an underground plate, and then to a box containing the isolating elements of pitch and petroleum, whence it is carried to the receiver at a distance and read off by a Morse apparatus, which in turn reproduces the communications transmitted back to the starting-point. The realization within a limited space of the theory of wireless tellurian telegraphy is therefore complete. A demonstration of the feasibility of the system is shortly to be made between Paris and Compiègne, and immediately afterwards between Paris and Brussels. Of course the radius of action depends upon the power of the electrodes, but Colonel de Pilsoudski declares that messages can traverse not only mountains and streams, but more easily still the sea.

An exposition will be held at Osaka in Japan from March 1 to July 31, 1903. The articles to be exhibited include agricultural, horticultural, forestry and water products; mining, industrial, and mechanical exhibits; and those pertaining to education, science, sanitation, economy and the fine arts. The articles shall be those collected, produced or manufactured by the subjects of the Empire, or by foreigners residing in Japan. The cost of the exposition is to be paid by the imperial treasury, except the expense of exhibiting, which will be borne by the exhibitors.

UNIVERSITY AND EDUCATIONAL NEWS.

The New York *Evening Post* states that Mrs. Mary Austin Carroll, of Boston, has just made a gift to the University of Virginia, by which the institution will receive during the remainder of her life an annual income of about $11,000. Mrs. Carroll's father, the late Arthur W. Austin, at his death twenty years ago left his estate of $400,000 in trust for the benefit of his daughter during her life, and at her death to go to the institution founded by Thomas Jefferson. Mrs. Carroll, sharing her father's love for the University, has just arranged to give for the rest of her life all her income except $5,000 a year, which she reserves for her own support.

The first meeting of the Trustees of the Carnegie Educational Fund was held in Edinburgh on July 15. Lord Elgin, who presided, read a letter from Mr. Carnegie announcing that he had signed a deed placing $10,000,000 at the disposal of the trustees.

The last general Assembly of Connecticut passed a bill giving an appropriation of $3,000 per annum to the Agricultural Experiment Station at New Haven for insect work and requiring that the station appoint a State entomologist and pay his salary. Mr. W. E. Britton was appointed to that office by the Board of Control at its meeting, June 10. The law also requires that all nurseries in the State be inspected once each year and that all nursery stock shipped into the State shall bear on each bale or package a certificate of inspection.

The position of Austin teaching fellow in histology and embryology at the Harvard Medical School is vacant. The value of the fellowship is $500, the appointment being annual. The holder is expected to give about one-third of his time to teaching in the laboratory and the remainder wholly to an original research, which must be approved by the professor in charge. In the prosecution of the research the large resources of the laboratory may be utilized. Applications should be accompanied by a statement of previous experience and work, and should be addressed to Dr. Charles S. Minot, Harvard Medical School, Boston, Mass.

Dr. F. L. Stevens, who has just returned from a year of study at Bonn, Halle and Naples in the capacity of travelling fellow of the University of Chicago, has been elected instructor in biology, in full charge of the department, in the College of Agriculture and Mechanic Arts, Raleigh, N. C.

N. E. Gilbert, A.B. (Wesleyan, 1895), Ph.D. (Johns Hopkins, 1901), has been appointed instructor in physics at Lehigh University.

Frederick H. Safford, Ph.D. (Harvard), has resigned from the mathematical staff of the University of Cincinnati.

At Birmingham University, Dr. A. H. R. Buller has been appointed lecturer in botany and Dr. R. C. Farmer demonstrator in chemistry.